UA113
.A2
T9
1943

TM 11-35

WAR DEPARTMENT TECHNICAL MAN

U.S. Dept. of Army

UNIVERSITY OF CALIFORNIA
LIBRARY
FEB 12 1945
DOCUMENTS DIVISION

LINE UNIT BE-77-

AND

LINE UNIT BE-77

WAR DEPARTMENT • 3 SEPTEMBER

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

WAR DEPARTMENT TECHNICAL MANUAL
TM 11-359

LINE UNIT BE-77-A
AND
LINE UNIT BE-77

WAR DEPARTMENT • 3 SEPTEMBER 1943

United States Government Printing Office
Washington : 1944

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA

TM 11-359
1945

TECHNICAL MANUAL

LINE UNITS BE-77, BE-77-A, AND BE-77-B

UNIVERSITY OF CALIFORNIA
FEB 7 1945
DOCUMENTS DIVISION

CHANGES No. 1

WAR DEPARTMENT
WASHINGTON 25, D. C., 18 January 1945

TM 11-359, 3 September 1943, is changed as follows:

The title of this manual is changed to read "**LINE UNITS BE-77, BE-77-A, AND BE-77-B.**"

1. General.

* * * * * * *

c. Line Unit BE-77-B (Added).—Line Unit BE-77-B is identical with Line Unit BE-77-A in circuits, operation, size, functioning of parts, and maintenance. All parts are electrically and mechanically interchangeable except the keys, which are electrically but not mechanically interchangeable.

SECTION IV

MAINTENANCE

Note (Added): Failure or unsatisfactory performance of equipment used by Army Ground Forces and Army Service Forces will be reported on WD AGO Form 468 (Unsatisfactory Equipment Report). If Form 468 is not available, see TM 38-250. Failure or unsatisfactory performance of equipment used by Army Air Forces will be reported on Army Air Forces Form 54 (Unsatisfactory Report).

* * * * * * *

28.1. Moistureproofing and Fungiproofing (Added).—*a. General.*—The operation of Signal Corps equipment in tropical areas where temperature and relative humidity are extremely high requires special attention. The following items represent problems which may be encountered in operation:

(1) Resistors, capacitors, chokes, and transformer windings fail.

(2) Electrolytic action takes place in resistors, chokes, transformer windings, etc., causing eventual break-down.

(3) Hook-up wire and cable insulation break-down. Fungus growth accelerates deterioration.

(4) Moisture forms electrical leakage paths on terminal boards and insulating strips, causing flash-overs.

b. Treatment.—A moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable

M558110

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

degree of protection against fungus growth, insects, corrosion, salt spray, and moisture. The treatment involves the use of a moisture- and fungus-resistant varnish applied with a spray gun or brush. See TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment, for a detailed description of the varnish-spray method of moistureproofing and fungiproofing and for the description and use of equipment and materials.

Caution: Varnish spray may have toxic effects if inhaled. To avoid inhaling spray, use respirator if available; otherwise, fasten cheesecloth or other cloth material over nose and mouth.

c. Step-by-step instructions for treating Line Unit BE–77.—(1) *Preparation.*—Make all repairs and adjustments necessary for proper operation of the equipment.

(2) *Disassembly.*—(*a*) Raise the cover, but do not disconnect wires.

(*b*) Remove the relay from its socket. Relay is not to be treated.

(*c*) Remove the fuse. This is not to be treated.

(*d*) Clean all dirt, dust, rust, fungus, oil, grease, etc., from the equipment to be processed.

(3) *Masking.*—Mask the following:

(*a*) Pin end of relay socket.

(*b*) Jack spring contacts and sleeve.

(*c*) Fuse clips.

(*d*) Lamp clips. (Do not remove lamp.)

(*e*) Binding posts.

(*f*) Switch openings and handles.

(*g*) Variable resistor.

(4) *Drying.*—Place equipment in an oven or under heat lamps and dry for 2 to 3 hours at 160° F.

(5) *Varnishing.*—Apply three coats of Lacquer, Fungus-resistant, Spec No. 71–2202 (Stock No. 6G1005.3) or equal, around the edge of the meter glass window and over the adjusting screw, and over all other parts and surfaces not covered by masking tape.

(6) *Reassembly.*—(*a*) Remove all masking tape after lacquer is dry.

(*b*) Replace the fuse and the relay.

(*c*) Lower the cover.

(*d*) Test the line unit for proper operation.

(7) *Marking.*—Mark the line unit, to show that it has been moistureproofed and fungiproofed, with "MFP" and the date of treatment.

Example: MFP__24 May 44.

d. Step-by-step instructions for treating Line Units BE–77–A and BE–77–B.—(1) *Preparation.*—Make all repairs and adjustments necessary for the proper operation of Line Units BE–77–A and BE–77–B.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

(2) *Disassembly.*—(*a*) Remove the six cover screws and lift the cover off, but do not disconnect the wiring.

(*b*) Remove the relay from its socket; relay is not to be treated.

(*c*) Clean all dirt, dust, rust, fungus, oil, grease, etc., from the equipment to be processed.

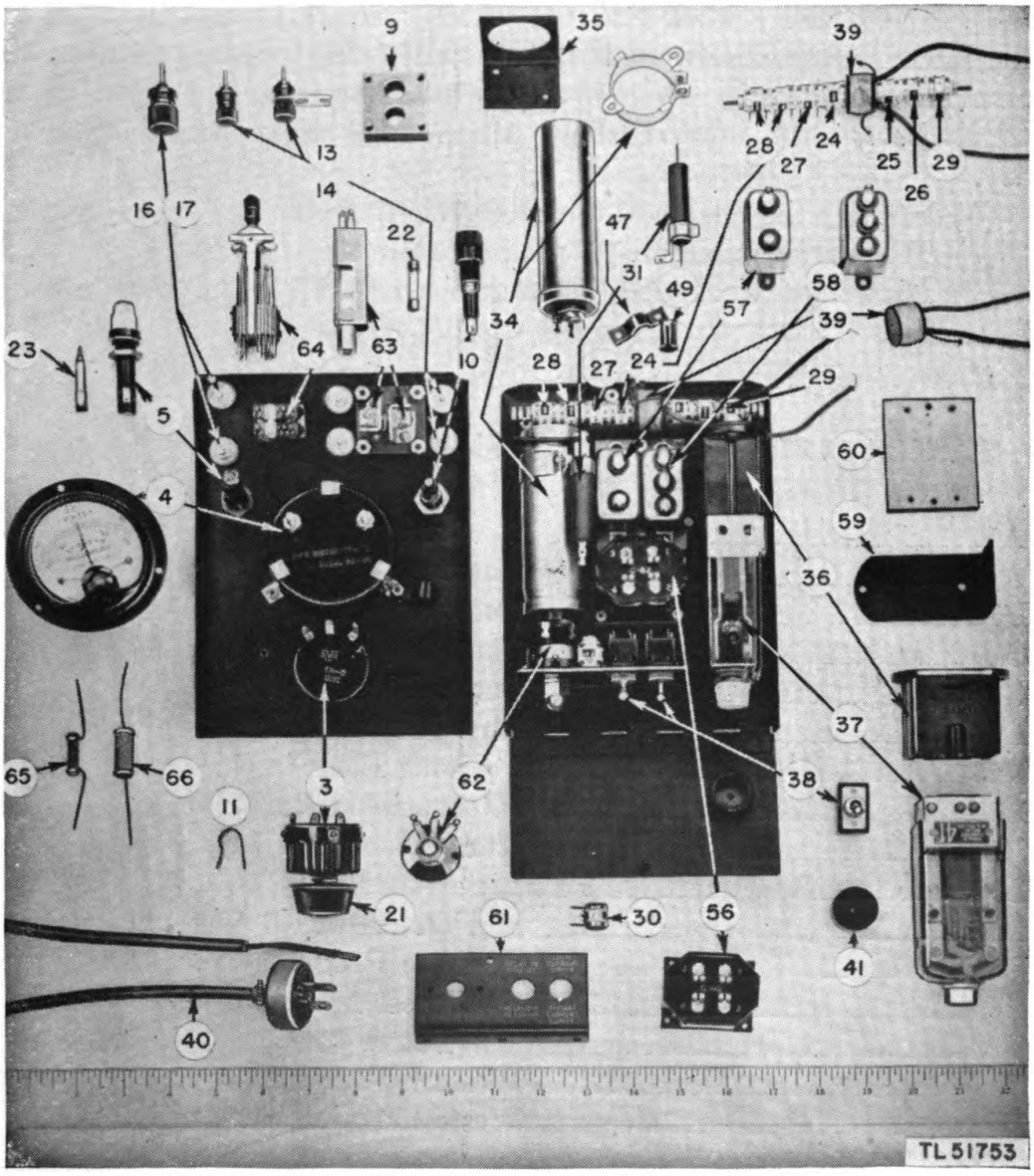


Figure 18.—Parts of Line Unit BE–77–B.

(3) *Masking.*—Mask the following:

(*a*) Pin end of relay socket.

(*b*) Jack spring contacts and sleeve.

(*c*) Key spring contacts.

(*d*) Line rheostat.

(*e*) Openings in switch housing.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

(*f*) Front of toggle switches.

(*g*) Openings in variable resistor.

(*h*) Nut on front of variable resistor of bias-measuring circuit.

(4) *Drying.*—Place the line unit in an oven and dry for 2 to 3 hours at 160° F.

(5) *Varnishing.*—Apply three coats of Lacquer, Fungus-resistant, Spec No. 71–2202 (Stock No. 6G1005.3) or equal, around the edge of the meter glass window and over the adjusting screw, and over all other parts and surfaces not covered by masking tape.

(6) *Reassembly.*—(*a*) Remove all masking tape after lacquer is dry.

(*b*) Replace the relay and the cover.

(*c*) Test the line unit for proper operation.

(7) *Marking*—Mark the line unit with "MFP" and the date of treatment.

Example: MFP--24 May 44.

32. List of Manufacturers (Added).

Code	*Manufacturer*
A1	Aerovox Corp.
A64	Automatic Signal Corp.
B9	Bussman Mfg. Co.
C10	Clarostat Mfg. Co.
C18	Cutler-Hammer, Inc.
E8	Eby, Hugh H., Inc.
F26	Ferranti Electric, Inc.
I2	International Resistance Co.
K6	Kurz-Kasch Co., Inc.
L3	Littelfuse Lab.
M21	Marion Electrical Instrument Co.
S8	Sprague Products Co.
S39	Shallcross Mfg. Co.
T29	The Potter Co.
W5	Western Electric Co.
W32	Western Union Telegraph Co.

[AG 300.7 (27 Nov 44)]

BY ORDER OF THE SECRETARY OF WAR:

OFFICIAL:
J. A. ULIO
Major General
The Adjutant General

G. C. MARSHALL
Chief of Staff

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

DISTRIBUTION:

AAF (5); AGF (5); ASF (2); T of Opn (5); Dept (5); Def Comd (2); Base Comd (5); AAF Comd (2); Arm & Sv Bd (2); S Div ASF (1); Tech Sv (2); SvC (5); Area AsvC (2); WDGS Lib (5); PC&S (2); PE (2); Dep 11 (2); Gen Oversea SOS Dep (Sig Sec) (2); GH (2); M Conc C (2); Air Base Hosp (2); Gen Sv Sch (5); Sp Sv Sch (10); USMA (2); ROTC (5); Lab 11 (2); Sig AS (2); Rep Sh 11 (2); A (5); D (2); AF (2);

Three (3) copies to each of the following: T/O & E 1-27; 1-37; 1-47; 1-130-1; 1-137; 1-147; 1-167; 1-252; 1-267; 1-312; 1-452T; 1-469S; 1-487S; 1-547; 1-637; 1-757; 1-758; 1-767; 1-777S; 1-779; 1-1027; 11-7; 11-18; 11-47; 11-57; 11-77; 11-87S; 11-97; 11-107; 11-127; 11-217; 11-237; 11-247; 11-257; 11-267; 11-287; 11-317; 11-400 Sig AW Org (Team K); 11-460-1S; 11-517S; 11-557; 11-587; 11-592; 11-597.

For explanation of symbols, see FM 21-6.

Digitized by Google

U. S. GOVERNMENT PRINTING OFFICE: 1943

Original from UNIVERSITY OF CALIFORNIA

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

TECHNICAL MANUAL
No. 11-359

WAR DEPARTMENT,
WASHINGTON, 3 September, 1943

LINE UNIT BE-77-A
AND
*LINE UNIT BE-77

This technical manual, published on Orders No. 13643-PHILA-43, and No. 31561-PHILA-43, is furnished for the information and guidance of all concerned.

TABLE OF CONTENTS

Paragraph

SECTION I. Description.

General 1
Description 2
Accessories 3

II. Installation and operation.

Installation procedure 4
Unpacking and setting up 5
Power source arrangements 6
Teletypewriter equipment connection and check 7
Ground connection 8
Testing the ground connection 9
Connection of the line 10
General line-up procedure 11
Line current supply 12
Line current adjustment 13
Line relay adjustment 14
Emergency arrangements 15
Operation 16
Line Unit BE-77, adjustment for polarential operation 17
Removal from service 18

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

SECTION III. Functioning of parts.

Operating circuits 19
Meter 20
Line current measurement, Line Unit BE-77-A 21
Voltage measurement, Line Unit BE-77-A 22
Bias measurement, Line Unit BE-77-A... 23

IV. Maintenance.

Servicing 24
Meters 25
Fuse 26
Relay 27
Line Unit BE-77-A, bias circuit adjustment 28

V. Supplementary data.

Table of Replaceable Parts for Line Unit BE-77-A 29
Table of Replaceable Parts for Line Unit BE-77 30
Names and addresses of manufacturers.. 31

*This manual supersedes information on Line Unit BE-77 contained in TM 11-354, Telegraph Printer Sets EE-97 and EE-98, 28 Dec. 42.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

LIST OF ILLUSTRATIONS

Fig. No.	Title	Page
1	Line Unit BE-77-A, general view	5
2	Line Unit BE-77-A as used in Teletypewriter Set EE-97-A	6
3	Line Unit BE-77, general view	7
4	Line Unit BE-77-A, door open	8
5	Line Unit BE-77, cover open	11
6	Line Unit BE-77-A, operating instructions plate	13
7	Line Unit BE-77, operating instructions plate	12
8	Line Unit BE-77-A, complete schematic diagram	24
9	Line Unit BE-77-A, simplified normal operating circuits	25
10	Line Unit BE-77-A, simplified circuit without line relay	26
11	Line Unit BE-77, schematic and wiring diagrams	27
12	Line Unit BE-77, simplified normal operating circuits	28
13	Line Unit BE-77, simplified circuit without relay	28
14	Line Unit BE-77, simplified polarential operating circuit	29
15	Line Unit BE-77-A, simplified bias-measuring circuit	30
16	Line Unit BE-77-A, wiring connections	33
17	Line Unit BE-77-A, location of parts	36

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

DESTRUCTION NOTICE

WHY —To prevent the enemy from using or salvaging this equipment for his benefit.

WHEN—When ordered by your commander, or when you are in immediate danger of capture.

HOW —1. Smash — Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools, etc.

2. Cut—Use axes, handaxes, machetes, etc.

3. Burn—Use gasoline, kerosene, oil, flame-throwers, incendiary grenades, etc.

4. Explosives—Use firearms, grenades, TNT, etc.

5. Disposal — Bury in slit trenches, foxholes, other holes. Throw in streams. Scatter.

USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT

WHAT—1. SMASH—Milliammeter, relay, rheostat, and other parts.

2. BURN—All remains, including this manual.

DESTROY EVERYTHING!

SAFETY NOTICE

THIS EQUIPMENT EMPLOYS VOLTAGES WHICH ARE DANGEROUS IF CONTACTED. BE ESPECIALLY CAREFUL WHEN MAKING LINE CONNECTIONS AND ADJUSTMENTS WITHIN THE EQUIPMENT.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

LINE UNIT BE-77-A AND BE-77

SECTION I

DESCRIPTION

	Paragraph
General	1
Description	2
Accessories	3

1. General.—*a. Line Unit BE-77-A.*—Line Unit BE-77-A (fig. 1) is a component part of Telegraph Printer Sets EE-97-A, EE-98-A, EE-102, and Reperforator Teletypewriter Sets TC-16 and TC-17. The unit may be issued as part of Telegraph Printer[1] Sets EE-97 and EE-98 in place of Line Unit BE-77[2]. The line unit is normally transported in a compartment in Chest CH-53-A,

[1] In accordance with Training Circular No. 41, W.D., 1942, the term teletypewriter is used in this manual hereafter in referring to equipment sometimes designated as "telegraph printer" or as "printer."

[2] A substantial number of BE-77's are, however, still in use. Line Unit BE-77 is therefore given parallel treatment in this manual wherever justified by differences between it and the more recent BE-77-A.

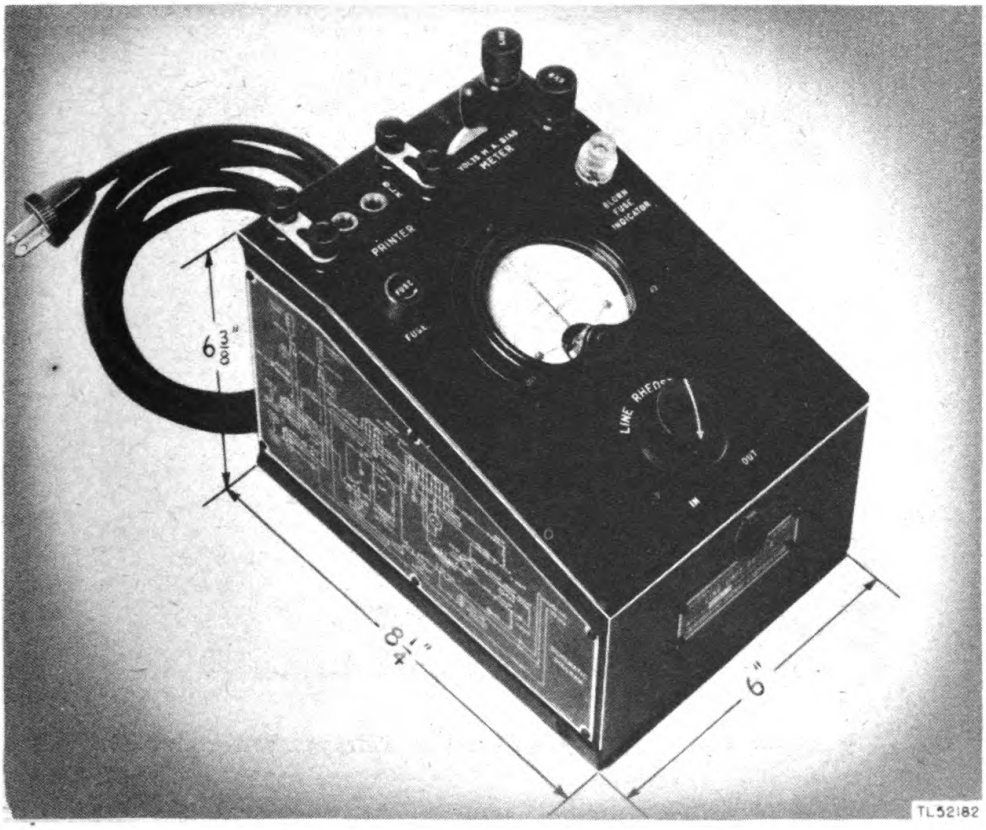


Figure 1.—Line Unit BE-77-A, General View.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

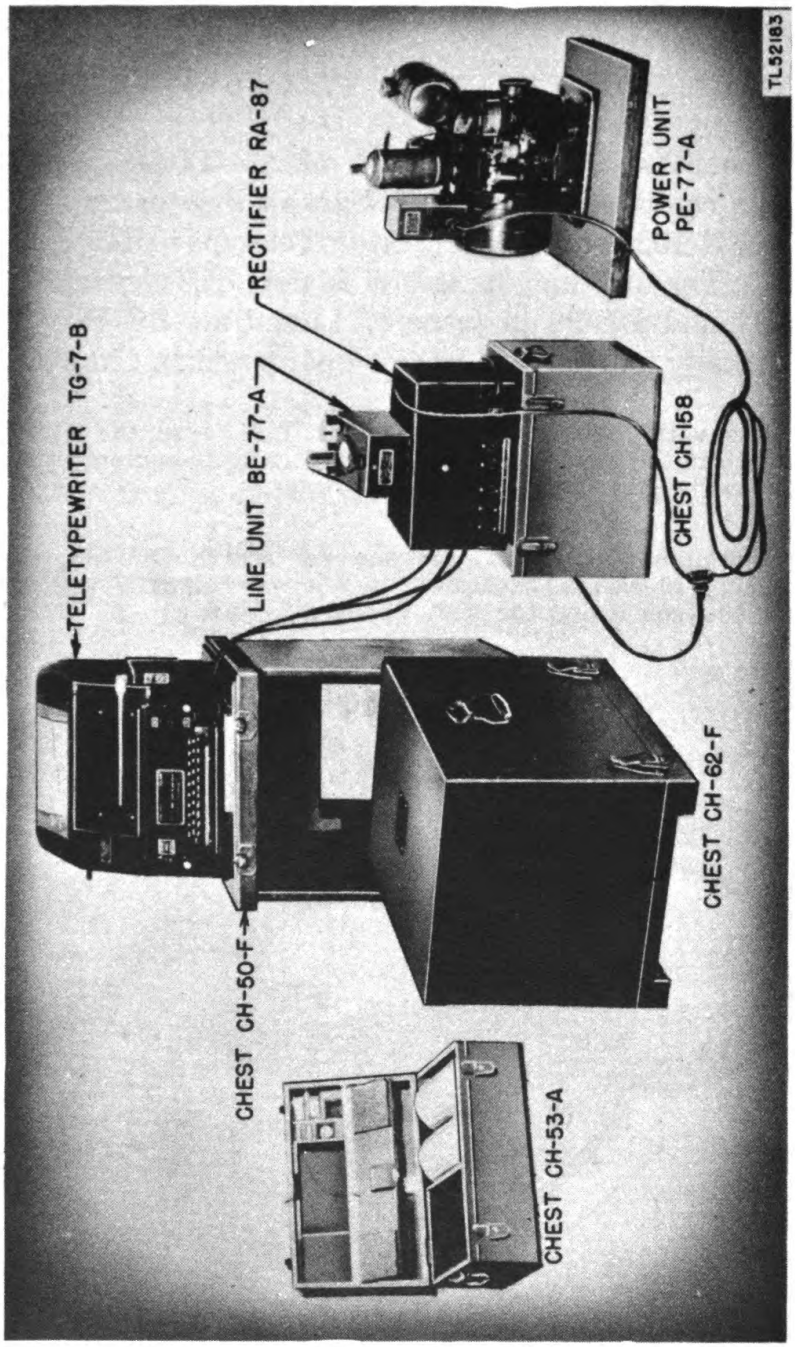


Figure 2.—Line Unit BE-77-A as used in Teletypewriter Set EE-97-A.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

which is a component of the teletypewriter sets mentioned above when Line Unit BE-77-A is issued. Line Unit BE-77-A is used to make necessary connections between neutral-type telegraph line circuits and teletypewriter station equipment (fig. 2), and repeats teletypewriter signals which are transmitted from the line into the teletypewriter receiving mechanism. The line unit may be used for measuring and adjusting line current, for measuring the voltage of the d-c power source, and for measuring and adjusting the quality of the received signals. Line Unit BE-77-A performs essentially the same functions as Line Unit BE-77. Line Unit BE-77-A also incorporates the bias-measuring

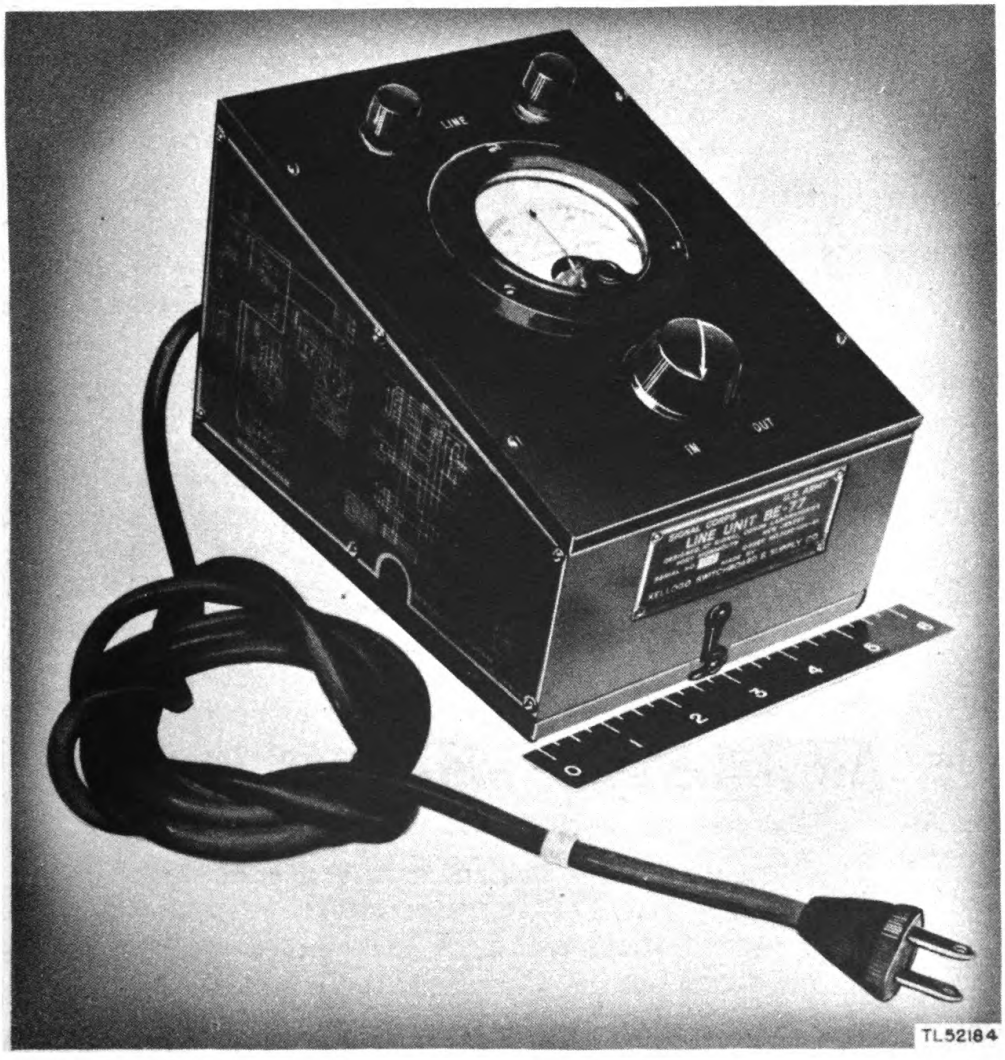


Figure 3.—Line Unit BE-77, General View.

612465 O—44——2

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

circuit provided in Bias Meter I-97-A and the voltage-measuring circuit provided in Voltmeter IS-170 and Cord CD-486. It does not, however, provide for operation on type A polarential lines.

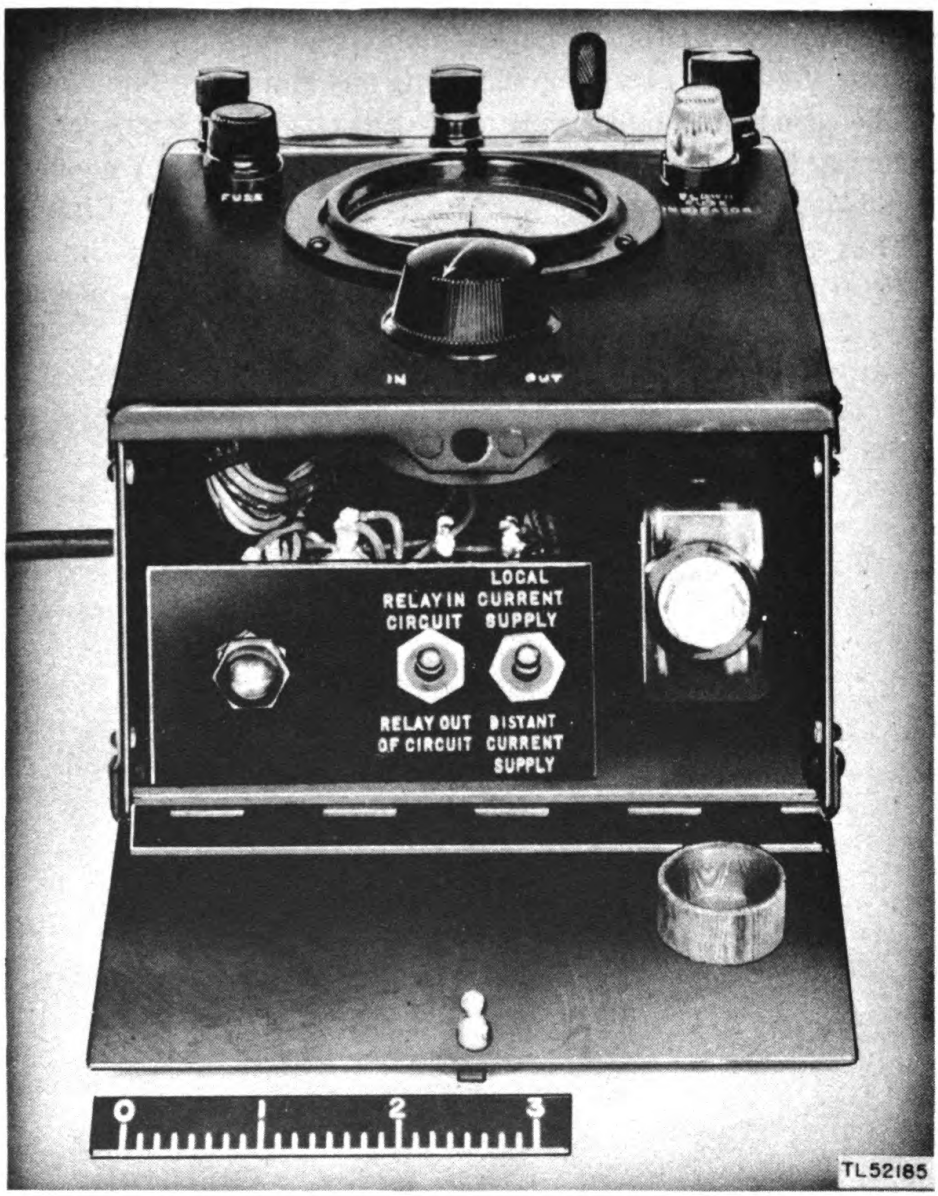


Figure 4.—Line Unit BE-77-A, door open.

b. Line Unit BE-77.—Line Unit BE-77 (fig. 3) is a component of Telegraph Printer Sets EE-97 and EE-98. It is normally transported in a compartment in Chest CH-53, another

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

component of the above-mentioned sets. The unit is used to make the necessary connections between neutral-type telegraph line circuits and teletypewriter station equipment, such as Printer TG-7-A. In addition, it may be used on polarential line circuits. As in Line Unit BE-77-A, provision is made for measuring and adjusting line current and for adjusting the quality of the received signals. No provision is made, however, for measuring supply voltage and the quality of received signals.

2. **Description.**—*a. Line Unit BE-77-A.*—Most of the components of the line unit, including the single-current Western Union 41-C relay, are mounted within a sheet-steel housing. Binding posts for line connections, binding posts and jacks for connection of teletypewriters, line-fuse and blown-fuse indicators, line rheostat, meter, and meter key are mounted on the top cover of the line unit (fig. 1). A door in the front of the housing gives access to the line relay and a switch panel, upon which the bias circuit adjustment and relay and line current switches are mounted (fig. 4). A power cord for connection to a source of direct current is located at the rear of the line unit. Condensed operating instructions are provided on the right-hand side of the line unit (fig. 6) and a schematic diagram is provided on the left-hand side (fig. 8). Line Unit BE-77-A weighs 9¼ pounds, and its dimensions are 6 x 8¼ x 6⅜ inches.

b. Line Unit BE-77.—The line unit consists of a relay, rheostat, milliammeter, and miscellaneous parts assembled in a wooden housing (figs. 3 and 5). The line unit weighs 6 pounds, and its dimensions are 6 x 7¾ x 6 inches.

3. **Accessories.**—Voltmeter IS-170 and Cord CD-486 are ordinarily used with Line Unit BE-77 to measure power supply voltages. Bias Meter I-97-A is designed for use in measuring and adjusting the bias of signals in the receiving mechanism circuit. (See TM 11-2200 Bias Meter I-97-A for further details.) None of the above accessories is a part of Line Unit BE-77 nor is needed with Line Unit BE-77-A.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

SECTION II

INSTALLATION AND OPERATION

	Paragraph
Installation procedure	4
Unpacking and setting up	5
Power source arrangements	6
Teletypewriter equipment connection and check	7
Ground connection	8
Testing the ground connection	9
Connection of the line	10
General line-up procedure	11
Line current supply	12
Line current adjustment	13
Line relay adjustment	14
Emergency arrangements	15
Operation	16
Line Unit BE-77, adjustment for polarential operation	17
Removal from service	18

4. Installation Procedure.—*a. General.*—For normal operation on neutral teletypewriter lines the instructions in the following paragraphs apply in general to both Line Units BE-77-A and BE-77. (See par. 17 for polarential operation of Line Unit BE-77.) References to controls and terminals are to those on Line Unit BE-77-A, unless otherwise indicated. Refer to figures 3, 5, 7, and 11 instead of figures 1, 2, and 4 for location of terminals, controls, and parts in BE-77, as the location and labeling of these items differ slightly in the two units.

b. Steps.—To install the unit, proceed as follows:

(1) Unpack and set up the line unit (par. 5).

(2) Determine, connect, and check the power source (par. 6).

(3) Connect the teletypewriter equipment to the line unit and check local operation (par. 7).

(4) Connect and check the ground connection if a ground return line is to be used (pars. 8 and 9).

(5) Connect the line and adjust the line current and relay bias (pars. 10 to 14).

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

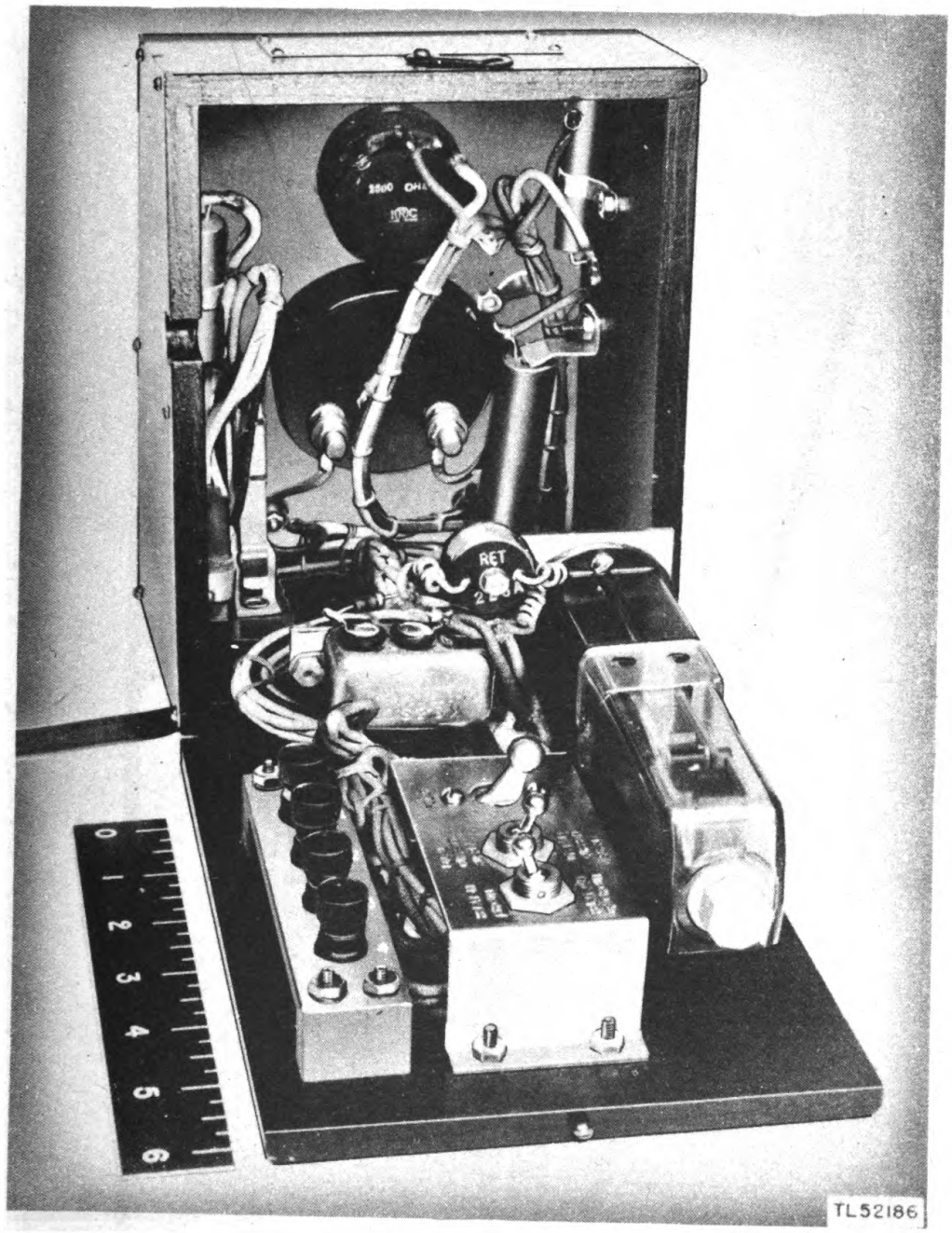


Figure 5.—Line Unit BE-77, cover open.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

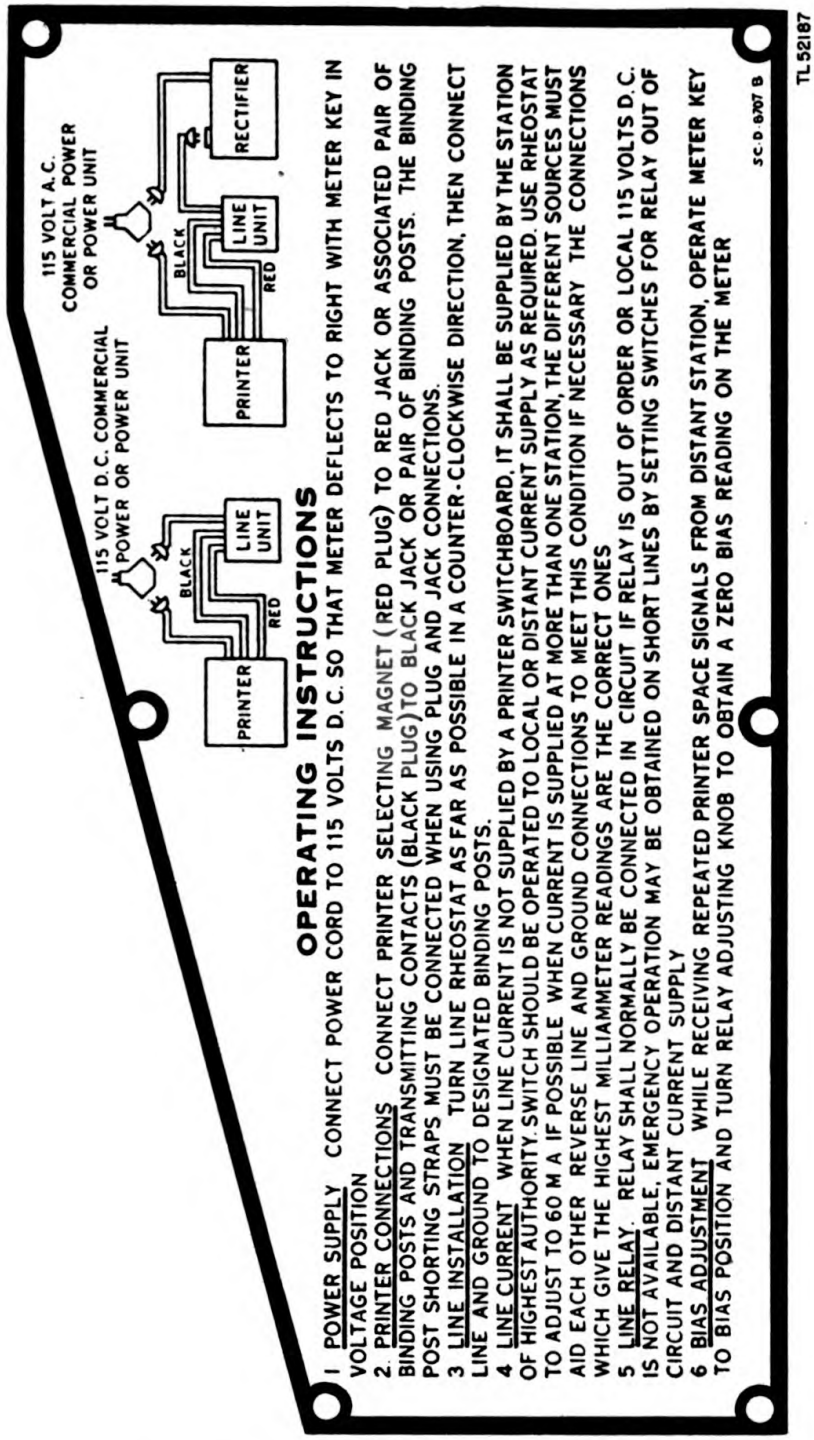


Figure 6.—Line Unit BE-77-A, operating instructions plate.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

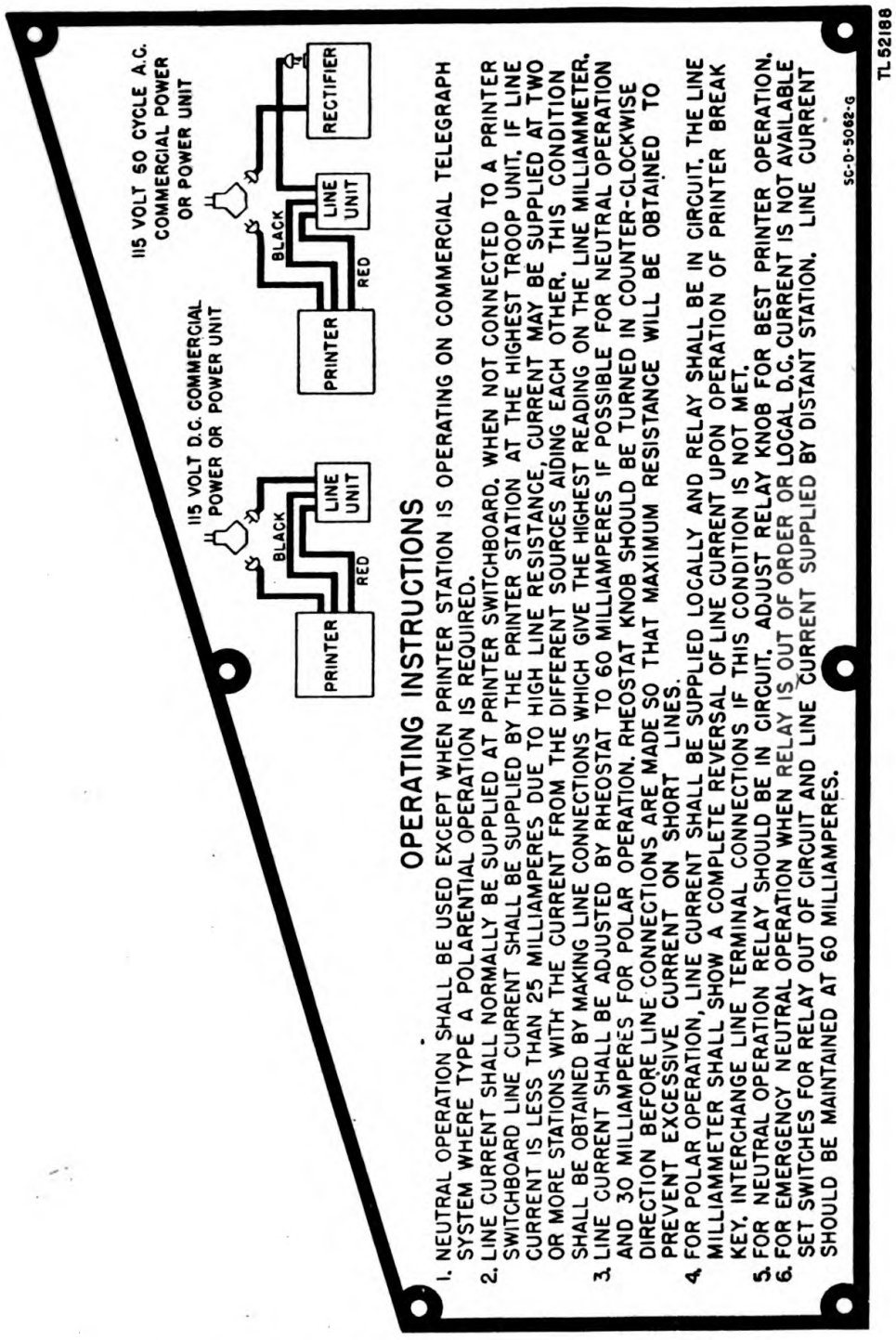


Figure 7.—Line Unit BE-77, operating instructions plate.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

CAUTION: TO PREVENT SHOCK IN MAKING CONNECTIONS ON THE *LINE* AND *GND* TERMINALS ON LINE UNIT BE-77-A, ALWAYS HAVE THE RIGHT-HAND TOGGLE SWITCH THROWN TO *DISTANT CURRENT SUPPLY*.

TO PREVENT SHOCK IN MAKING CONNECTIONS TO THE *LINE* BINDING POSTS ON LINE UNIT BE-77, ALWAYS REMOVE THE POWER CORD PLUG FROM THE POWER SOURCE. PLACING THE TOGGLE SWITCH IN THE *DISTANT LINE CURRENT* POSITION DOES NOT REMOVE ALL VOLTAGE FROM THESE BINDING POSTS.

5. **Unpacking and Setting-Up.**—Remove the line unit from the compartment of its packing chest. Place the unit to the right of the teletypewriter and at a height that will permit convenient operation. If a rectifier is used with the equipment, place the unit on top of the rectifier. Check the line unit for loose or defective parts.

6. **Power Source Arrangements.**—*a. Suitable power source.* —A power source for the line unit must be capable of supplying *at least 0.140 amperes direct current* at 115 volts. Depending upon the power sources and power conversion equipment available, the line unit may be supplied with d-c power from commercial or military sources of alternating current at various voltages by means of rectifiers. D-C gasoline engine generator sets or other commercial or military d-c power sources may be employed.

CAUTION: WHEN EMPLOYING A GROUNDED D-C POWER SOURCE, USE EXTREME CARE IN MAKING THE LINE AND GROUND CONNECTION TO PREVENT SHORTING OF THE POWER SUPPLY OR BUCKING OF THE LINE CURRENTS.

If a source of d-c power is not available, it *may* be possible to operate the connected equipment satisfactorily without a source of power for the line unit (see par. 15 *b*).

b. Power source connection and voltage check with Line Unit BE-77-A.—Connect the line unit power cord to any suitable 115-volt d-c power source and throw the METER key to VOLTS. The power source voltage is correct when the meter reads anywhere within the group of three red lines immediately under the numeral 115 on either side of the scale. If the meter records incorrect voltage, adjust the voltage at the rectifier, power unit,

Digitized by Google Original from UNIVERSITY OF CALIFORNIA

or other source. The voltage of the power source can be checked without interrupting the transmission or reception of messages through the line unit.

c. Checking power source voltage when using Line Unit BE-77.—When using Line Unit BE-77, the power supply voltage must be checked with a separate voltmeter such as Voltmeter IS-170. This voltmeter is connected to the power supply with Cord CD-486. Adjust the voltage for a reading of 115.

7. Teletypewriter Equipment Connection and Check. — *a. Connection.*—The usual connection diagrams are shown in the operating instructions plate on the right-hand side of the unit (fig. 6 or 7). Connect the red (receiving) and black (transmitting) plugs on the teletypewriter equipment to their respective PRINTER jacks in the line unit. If the receiving and transmitting cords are not equipped with plugs, they may be connected to the binding posts provided. (For BE-77, see Fig. 11). To prevent shock, remove the power cord plug from the power source when making connections to these binding posts. In Line Unit BE-77-A the binding post shorting straps must be disconnected when using the binding posts and connected when using the PRINTER jacks. Arrange the teletypewriter equipment for the source of motor power to be used and connect the teletypewriter power cord to the source of power for the motor.

b. Check of local operation.—(1) Throw the toggle switch to RELAY IN CIRCUIT (fig. 4). On Line Unit BE-77, also throw the POLAR-NEUTRAL toggle switch to the NEUTRAL position.

(2) Throw the toggle switch to DISTANT CURRENT SUPPLY (fig. 4). This removes the power supply voltage from the LINE and GND binding posts except on Line Unit BE-77.

(3) Turn the LINE RHEOSTAT to its extreme counterclockwise (IN) position (fig. 1).

(4) Connect the LINE binding post to the GND binding post (fig. 1) with a short length of insulated wire.

(5) Throw the right-hand toggle switch to LOCAL CURRENT SUPPLY (fig. 4) and adjust the LINE RHEOSTAT for a reading of 60 on the meter.

612465 O—44——3

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

(6) Check the setting of the teletypewriter range finder and speed. The range finder should be as set by the maintenance man, usually between 50 and 60 on the scale. One line of space bar signals should require about 11 seconds of transmission time. (See applicable technical manuals for details.)

(7) Send the letters R and Y alternately for about one line of typing.

(8) If the R's and Y's are printed correctly, the local operation of the machine and line unit is satisfactory. If the R's and Y's are not printed correctly, adjust the white relay knob to the right of the toggle switches (fig. 4). This knob turns very easily and requires about 5 to 8 turns for the complete range of adjustment. Operation of the machine itself can be checked by throwing the left-hand toggle switch to RELAY OUT OF CIRCUIT. Do not attempt a line-up of the line unit until satisfactory local operation has been obtained.

8. **Ground Connection.**—*a. General.*—The ground connection is very important if a ground return line circuit is to be used. A high resistance ground connection may introduce so much resistance into the circuit that it will be impossible to obtain the proper operating current. It is also easily affected by changes in the weather, and frequent line-up or readjustment of the circuit is therefore required.

b. Selection of a ground connection.—For the ground connection, select a water system, well pipe, or other large, well-grounded metallic object if any of these is available. Avoid separate grounds used for power systems, telephone instruments, and lightning arresters. Where water systems or the equivalent are not available, select the lowest and dampest site possible, preferably one near or in a stream bed or other such body of water, and install ground rods. Select a site with soil containing cinders, brine waste, mineral salts, clay, and loam. Avoid sites with frozen ground or with soil containing greasy waste materials, dry sand, gravel, and rock. A good ground at the end of 100 or 200 yards of field wire is better than a poor ground 10 feet from the line unit.

Digitized by Google Original from UNIVERSITY OF CALIFORNIA

c. Making the ground connection.—(1) *Single ground connection.*—If a water pipe or similar metal object is to be used, scrape the surface clean near the point at which the pipe enters the ground and install a ground clamp. If a ground clamp is not available, wrap about 10 turns of bare field wire around the pipe, tie the wire tightly, and tape over the wrapped connection. Run the field wire pair to the line unit.

(2) *Double ground connection.*—If ground rods are to be used, dig two holes at least 10 feet apart (preferably 10 yards apart), about 6 inches deep, and 1 foot in diameter. Drive a Ground Rod GP-29 into each hole until its top is 3 inches above the bottom of the hole. To prevent whipping of the rod and enlargement of the hole, hit the rod squarely and only hard enough to drive it into the ground. A loose rod will cause a poor ground connection. Connect one wire of a field wire pair to one ground rod and the other wire to the other ground rod. Be sure the connections are good. Run the field wire pair to the line unit.

d. Improving ground connections.—Ground connections can be improved by using more ground rods, driving them in more deeply, or soaking the adjoining ground with a solution of salt in water. In frozen ground, the ground rod must extend well below the frost line. Except in the winter, a satisfactory ground connection may frequently be obtained by using several spikes or nails driven into the base of a tree with a large, deep root system.

9. Testing the Ground Connection.—*a. Single ground connections.*—It is not practicable to test single ground connections to water pipes and similar objects. If in doubt about such connections, install a ground rod or other separate ground; then test, and use the connection as a double ground connection.

b. Double ground rod connections.—(1) Connect one wire of the field wire pair from the ground rods to the LINE binding post and the other wire to the GND binding post.

(2) If the local operation check of paragraph 7*b* has not been made, perform steps (1) to (5), connecting the jumper wire between the binding posts so that it can be easily removed and applied without danger of shock.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

(3) Watch the meter and note the reading when the jumper is removed.

(4) If the meter reading changes from about 60 to any value *above 40* when the jumper is removed, the ground connection will be satisfactory (less than 240 ohms). (See par. 8*d* for methods of improving the ground connection.)

(5) Remove the jumper and connect both wires of the field wire pair to the GND binding post.

10. Connection of the Line.—*a.* Turn the LINE RHEOSTAT knob counterclockwise as far as it will go.

b. Throw the toggle switch to DISTANT CURRENT SUPPLY.

c. For ground return circuits, connect the ground wire to the GND binding post (pars. 8 and 9) and the line wire to the LINE binding post.

CAUTION: TO PREVENT SHOCK, HANDLE LINE WIRES CAREFULLY. VOLTAGE MAY BE CONNECTED AT THE DISTANT TERMINAL.

d. For metallic return line circuits, connect one line wire to the GND binding post and the other to the LINE binding post. Do not make a ground connection to the GND binding post.

e. If the station is to be a way station on a circuit, connect the line running in one direction to one binding post and the line running in the opposite direction to the other. Do not make a ground connection to the GND binding post.

11. General Line-Up Procedure.—*a. General.*—Line-up of the circuit will ordinarily consist of arranging for the supply of line current, adjusting the line current, and adjusting the relays at each end of the circuit (pars. 12, 13, and 14).

b. Signals.—Prior to completion of the circuit line-up, it will generally be necessary to carry on communication by means of break signals which can be observed on the line unit meter. To avoid confusion during the adjustment and line-up of the circuit, and in the absence of other orders, the following meanings of break signals are suggested for this use:

Digitized by Google Original from UNIVERSITY OF CALIFORNIA

(1) One 3-second break signal means: "Stop transmission. I am through with my adjustment and will send repeated space bar signals."

(2) Two 3-second break signals sent by a control terminal mean: "Arrange to supply line current."

c. Control terminal.—(1) The line-up of a circuit should be under the control of the switchboard operator when the circuit from a line unit terminates on a swichboard. When the circuit is between two stations, the line-up will be controlled by the station operator at the higher headquarters. When the circuit is between two stations of equal authority, the control will be under the headquarters bearing the lower numerical designation.

(2) Since it is the usual case, paragraphs 13 and 14 describe the line-up procedure as performed between a station (noncontrol terminal) and a switchboard (control terminal). If the switchboard should, however, be replaced by a station, the replacing station would assume the control functions outlined for the switchboard.

12. Line Current Supply.—*a.* Line current will normally be supplied by the control terminal only (switchboard or station of higher authority). It may be necessary at times, however, to supply line circuit from both terminals of a circuit.

b. When the station is to supply line current (either as a control terminal or otherwise), the right-hand toggle switch should be in the LOCAL CURRENT SUPPLY position. (The rheostat should be IN when the switch is thrown.)

c. When the station is not to supply line current (as a noncontrol terminal), the toggle switch should be in the DISTANT CURRENT SUPPLY position.

13. Line Current Adjustment.—*a.* The station operator (at the noncontrol terminal) will check to see that the right-hand toggle switch on his line unit is in the DISTANT CURRENT SUPPLY position. While watching the meter, he will turn the LINE RHEOSTAT knob clockwise as far as it will go. If there is any line current, it must be kept below 90 milliamperes. The station operator will then watch the meter for signals from the switchboard operator.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

b. The meter will indicate a line current of about 60 milliamperes when the switchboard operator completes his adjustment of the line current (subpar. *d* below).

c. The meter will now indicate a varying current of about 20 milliamperes when the switchboard operator sends space bar signals for the adjustment of the line unit relay (par. 14).

d. If, in subparagraph *b*, the meter indicates two 3-second break signals (zero current on the meter), turn the line unit LINE RHEOSTAT knob all the way counterclockwise (IN) and throw the toggle switch to LOCAL CURRENT SUPPLY. Now turn the rheostat knob clockwise as far as it will go, being careful not to turn it farther than is required to obtain a reading of 70 milliamperes on the meter. If the line current decreases when the toggle switch is thrown, reverse the line unit power cord plug in the power source socket. The line current will then be readjusted by the switchboard operator to about 60 milliamperes (sub par. *b*). Even though it may not always be possible to obtain a line current of 60 milliamperes, the relay adjustment in paragraph 14 should be completed, as it is frequently possible to obtain satisfactory operation with line currents as low as 30 or 35 milliamperes.

14. Line Relay Adjustment.—*a. General.*—Upon receipt of repeated space bar signals from the switchboard operator after adjustment of line current (par. 13), the station operator adjusts the relay in his line unit for best operation, as indicated in subparagraphs *b*, *c*, or *d* below. The line-up of the circuit is then completed as indicated in subparagraph *e*. Before starting the relay adjustment, check to see that the toggle switch is set for the RELAY IN CIRCUIT.

b. Line Unit BE-77-A.—(1) Hold the METER key in the BIAS position (to the right).

CAUTION: ALWAYS BE SURE THAT ONLY SPACE BAR SIGNALS ARE BEING RECEIVED BEFORE HOLDING THE KEY IN THE *BIAS* POSITION.

(2) Adjust the relay knob until the vibrations of the meter needle center on the zero mark on the meter scale (zero bias).

Digitized by Google Original from UNIVERSITY OF CALIFORNIA

(3) Release the METER key.

(4) Send a break signal and proceed as in subparagraph *e* below.

c. Line Unit BE-77 with Bias Meter I-97-A.—If a bias meter is available, remove the line relay from the line unit and place it in the socket provided in the bias meter. Plug the bias meter adapter plug into the line unit relay socket and connect the bias meter power cord to the 115-volt d-c source. The bias is then measured and the relay adjusted as described in *b* above, except that the button on the bias meter is depressed when reading bias. When the line-up is completed (subpar. *e* below), throw the toggle switch to RELAY OUT, disconnect the bias meter, return the line relay to its socket in the line unit, and throw the toggle switch back to RELAY IN. (See TM 11-2200 Bias Meter I-97-A for further details.)

d. Line Unit BE-77 without Bias Meter I-97-A. — This method of adjustment is not as satisfactory as that in which the bias meter is used, and may have to be supplemented at times by a fine adjustment when receiving test traffic.

(1) While receiving space bar signals, turn the relay adjusting knob counterclockwise until garbled reception is observed.

(2) Then turn the knob clockwise, counting the turns until garbled reception is again observed.

(3) Now turn the knob back counterclockwise one-half the number of turns counted in (2).

(4) Send a break signal and proceed as indicated in subparagraph *e* below.

e. Completion of the circuit line-up. — (1) Transmission from the switchboard will stop upon sending the 3-second break signal (subpars. *b* or *d* above).

(2) Start sending repeated space bar signals so that the switchboard operator can adjust his line relay.

(3) Stop sending space bar signals when a 3-second break signal is received from the switchboard operator upon completion of his line relay adjustment.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

(4) Check the test traffic received from the switchboard operator and then send test traffic. Receipt of accurate copy at both ends indicates that the line-up is correct and that the circuit is ready to handle traffic.

(5) On very short lines it may not be possible to adjust the line relay for zero bias, as indicated in subparagraphs *b* or *c* above. Satisfactory operation may, however, be achieved in such cases. In other cases, the most common cause of failure to obtain proper operation is a poor line condition due to bad splices, damaged insulation, or poor ground connections.

15. Emergency Arrangements. — *a. Faulty relay.* — When the relay is found to be damaged or defective, and cannot be replaced, it is sometimes possible to obtain satisfactory operation over short lines by throwing the left-hand toggle switch to the RELAY OUT OF CIRCUIT position. Recheck the line current to be sure that it is between 60 and 65 ma. Line current may be supplied if desirable.

b. No d-c supply available.—If a suitable source of direct current is not available, it is sometimes possible to obtain satisfactory operation over short lines by throwing the toggle switches to the RELAY OUT OF CIRCUIT and DISTANT CURRENT SUPPLY positions. Recheck the line current to be sure that it is between 60 and 65 ma.

16. Operation.—After being lined up on a particular line circuit (pars. 11 to 14), the line unit requires only the occasional checks listed below during the operation of associated teletypewriter equipment.

a. Check the line current to see that the reading has not changed. Readjust if necessary.

b. Check for errors in received copy. If any are found, readjust the line relay (par. 14).

c. If the line condition changes after the original circuit line-up, the relay adjustment should be checked (par. 14) even though accurate copy is received. Line conditions will alter with changes from dry to wet weather, and between night and day conditions.

d. Recheck both the line current and relay adjustment if the line circuit has been out of operation for more than a short time.

Digitized by Google Original from UNIVERSITY OF CALIFORNIA

17. Line Unit BE-77, Adjustment for Polarential Operation.—Type A polarential operation may be required on some commercial lines. The telegraph company furnishing the line will specify the type of operation to be used. When type A polarential operation is specified, throw the toggle switches to the POLAR, LOCAL LINE CURRENT, and RELAY IN positions and turn the line rheostat knob to its extreme clockwise position (OUT). The telegraph company will adjust the line current to about 30 milliamperes and the relay will be adjusted as indicated in paragraph 14.

18. Removal from Service.—Disconnect the line unit power cord from the power source and the teletypewriter leads and line wires from the line unit. Replace the line unit in its chest.

SECTION III

FUNCTIONING OF PARTS

	Paragraph
Operating circuits	19
Meter	20
Line current measurement, Line Unit BE-77-A	21
Voltage measurement, Line Unit BE-77-A	22
Bias measurement, Line Unit BE-77-A	23

19. Operating Circuits.—*a. Line Unit BE-77-A.*—The complete schematic circuit is shown in figure 8. The usual method of operation is with the relay in the circuit and line current supplied by a switchboard (toggle switches in RELAY IN CIRCUIT and DISTANT CURRENT SUPPLY positions). The simplified circuit omitting switch contacts, filter circuits, and unused portions of the circuit is shown in figure 9. The line current from the distant station flows through the ¼-ampere fuse, the rheostat, the meter and its shunt, the relay coils, and the teletypewriter equipment transmitting contacts. The line

612465 O—44——4

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

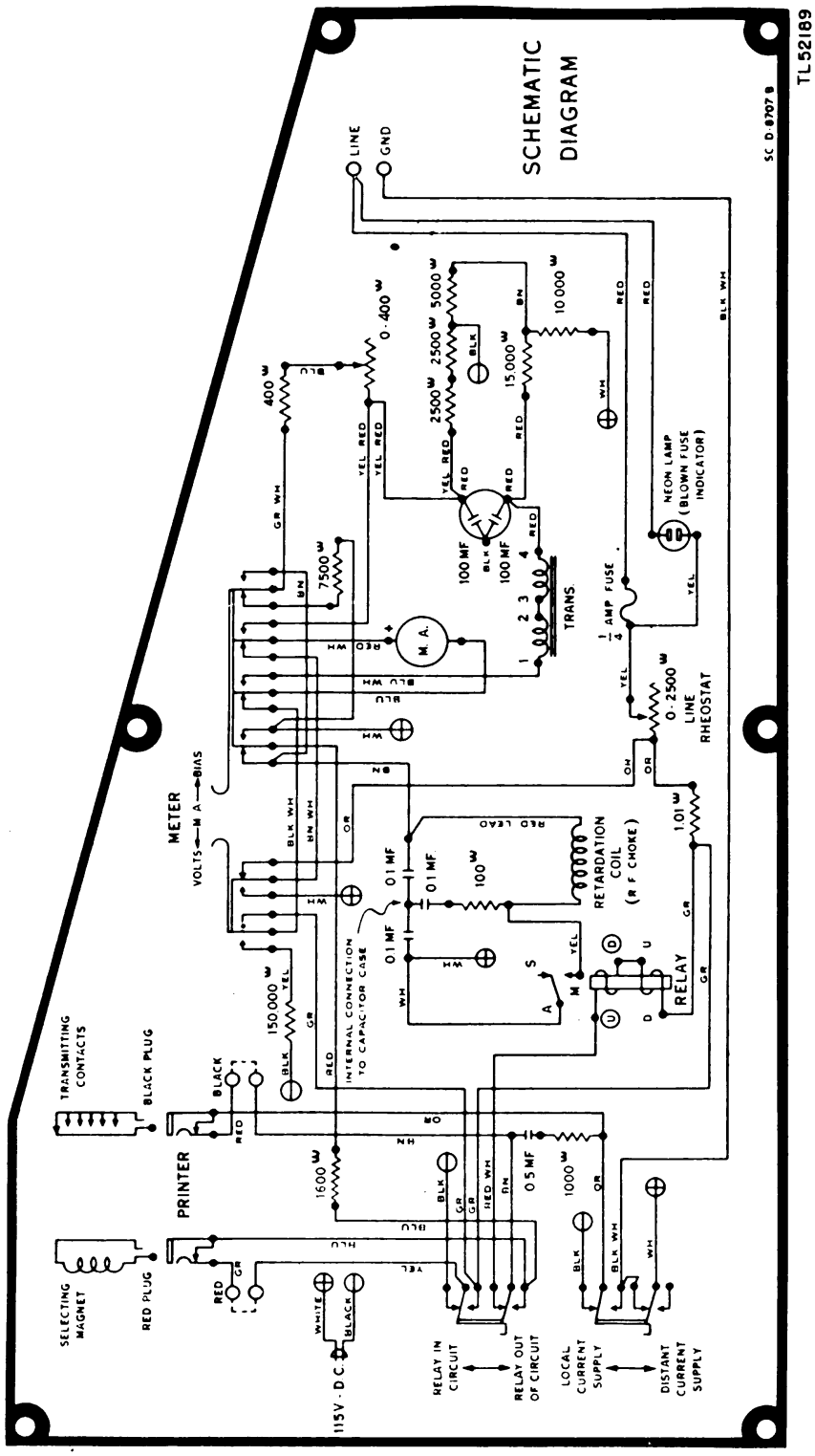


Figure 8.—Line Unit BE-77-A, complete schematic diagram.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

circuit is completed through the ground (or one line conductor when a metallic return is used), the switchboard circuit, and the line conductor to the LINE binding post. Signals from the line actuate the relay, thus repeating the signals to the teletypewriter receiving magnet through the 1,600-ohm resistor and the d-c power supply. Much of the distortion which may be present in the incoming line signals can be removed from the signal repeated to the receiving magnets by proper adjustment of the line relay (par. 14). The 1,600-ohm resistor limits the current through the receiving magnet to its normal value of 60 to 65 milliamperes. Signals sent by the transmitting contacts actuate the line relay in the same manner as do the incoming signals. There is, however, less distortion in the transmitted signals to be removed by the relay. If it becomes necessary to operate without use of the relay (toggle switch in RELAY OUT OF CIRCUIT position), the transmitting contacts and receiving magnet are connected

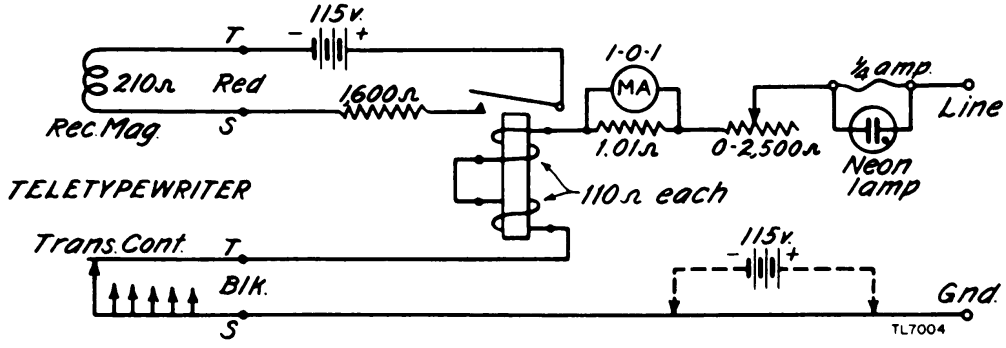


Figure 9.—Line Unit BE-77-A, simplified normal operating circuits.

directly in the line circuit as shown in figure 10. The relay may be removed when not in use without affecting operation of the circuit. When line current is supplied by the line unit (toggle switch in LOCAL CURRENT SUPPLY position) the d-c power source is connected to the GND terminal as shown by the dotted connection in figures 9 and 10.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

b. Line Unit BE-77.—(1) The complete schematic diagram is shown on the left-hand side of the unit (fig. 11). The usual method of operation is with the relay in the circuit and line current supplied by the switchboard, as shown in the simplified circuit of figure 12. With the relay out of the circuit, the simplified circuit is as shown in figure 13. Except for minor differences in the order of connecting the various parts, these circuits are the same as those shown for Line Unit BE-77-A in figures 9 and 10, and function in essentially the same manner. The meter has an internal shunt and gives a full-scale deflection on a current of 100 milliamperes. It is used to measure line current only, and cannot be used for voltage and bias measurement, as in the case of Line Unit BE-77-A.

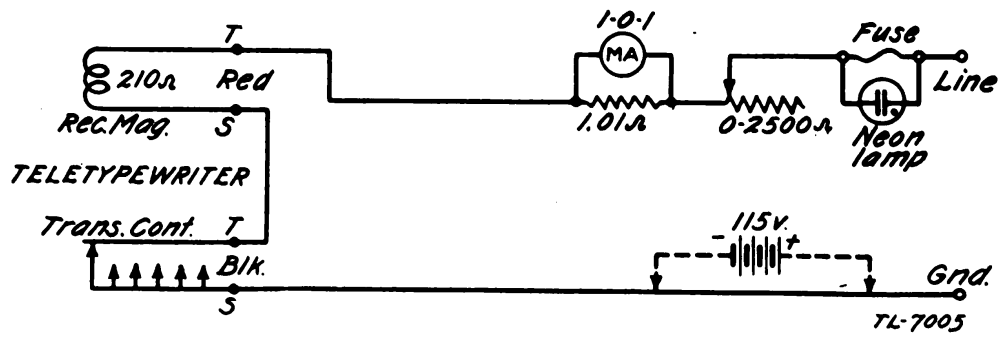


Figure 10.—Line Unit BE-77-A, simplified circuit without line relay.

(2) In the special case where the line unit is to be operated as part of an outlying station on a Bell System type A polarential circuit, the simplified line unit circuit will be as shown in figure 14. The lower relay winding is used as a biasing winding, the current being limited to 30 milliamperes by the 3,600-ohm resistor. When receiving signals, negative and positive currents of 30 milliamperes are transmitted from the distant commercial installation and pass through the upper line relay coil and the closed teletypewriter transmitting contacts. The negative line current aids the biasing current in holding the line relay contacts closed. The positive line current neutralizes the effect of the

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

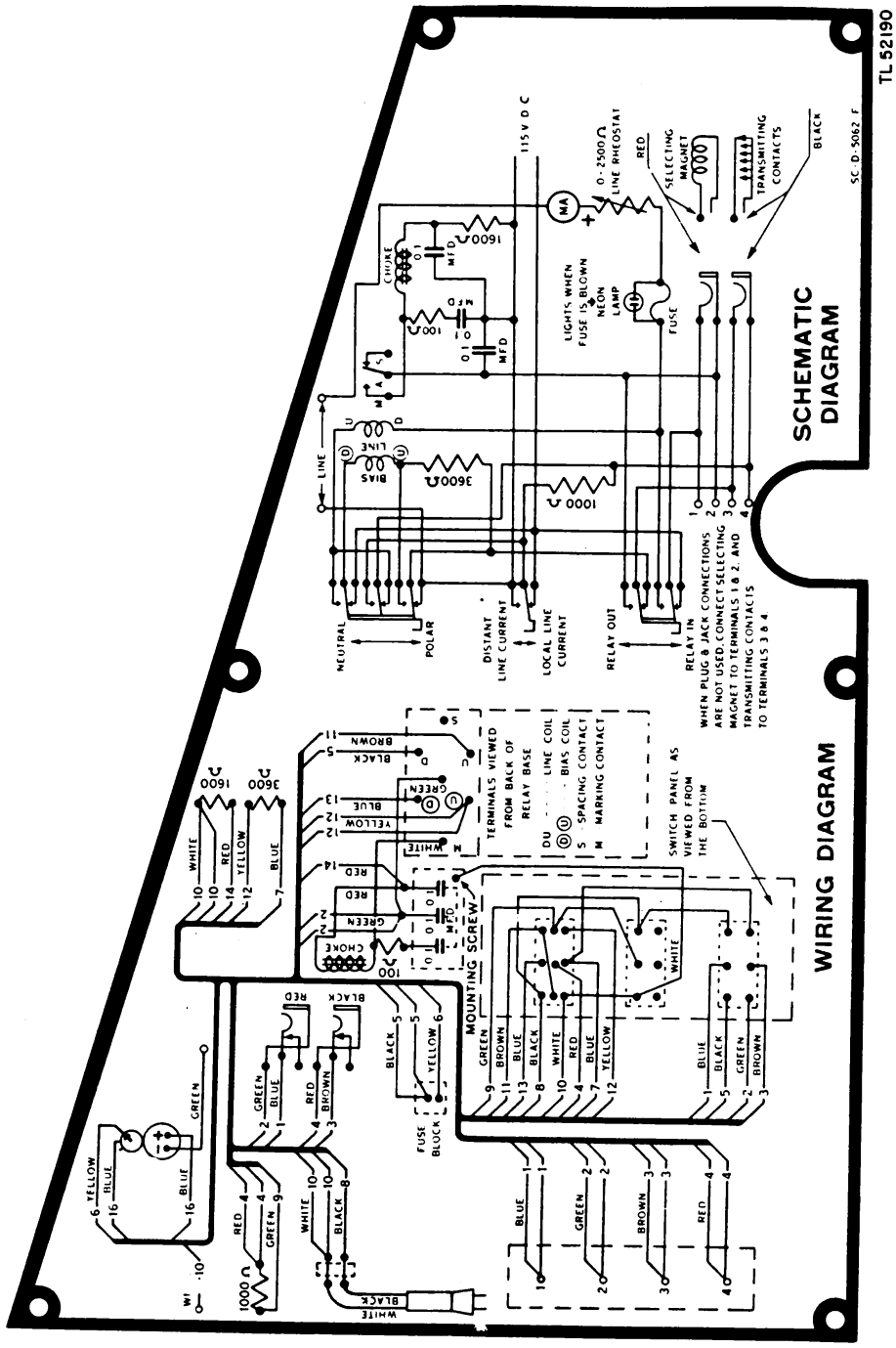


Figure 11.—Line Unit BE-77, schematic and wiring diagrams.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

biasing current so that the relay armature spring opens the relay contacts, thus allowing a spacing signal to be sent to the receiving magnet. When spacing signals are transmitted to the line, the teletypewriter transmitting contacts are opened and

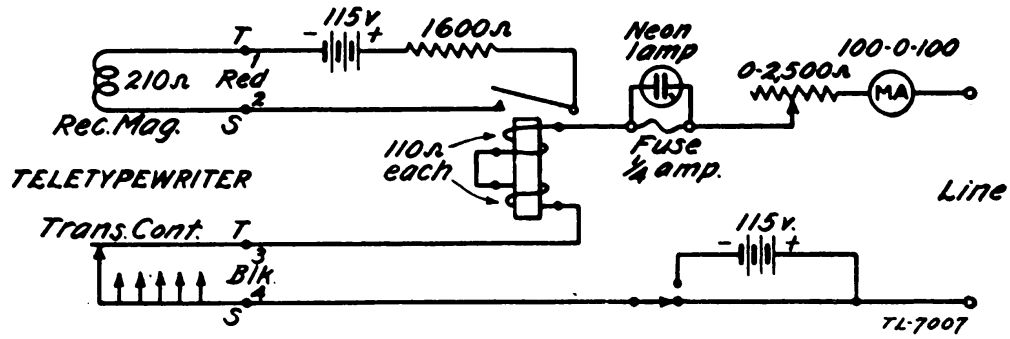


Figure 12.—Line Unit BE-77, simplified normal operating circuit.

the 115-volt local current supply is inserted into the line. The insertion of the local current supply into the line reverses the line current, thus sending a spacing signal to the distant installation. In transmitting, the receiving magnet is actuated by signals from the line unit in the same manner as in receiving.

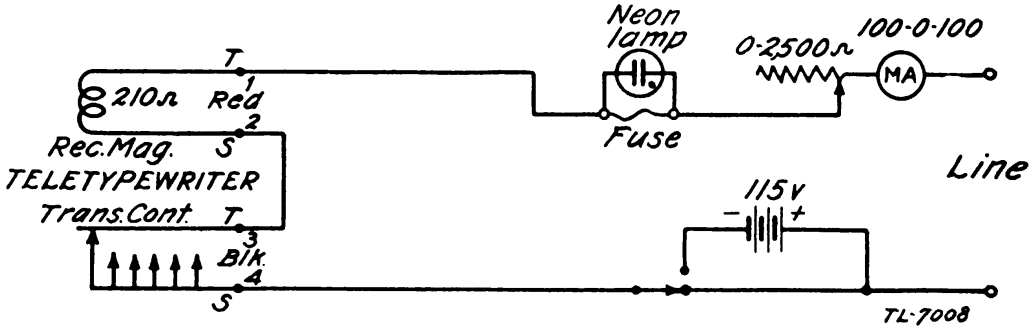


Figure 13.—Line Unit BE-77, simplified circuit without relay.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

20. Meter.—The meter used with Line Unit BE-77-A is very sensitive and requires a direct current of 1 milliampere for a full-scale reading (0.1 volts across its terminals). The meter used with Line Unit BE-77 requires 100 milliamperes for a full-scale reading and has no external shunt.

21. Line Current Measurement, Line Unit BE-77-A.—The meter will read line currents of either polarity unless the METER switch is held in the VOLTS or BIAS positions. The meter shunt for the line current is permanently wired into the line circuit. For a full-scale reading (a line current of 100 milliamperes), 99 milliamperes go through the 1.01-ohm shunt and 1 milliampere goes through the meter.

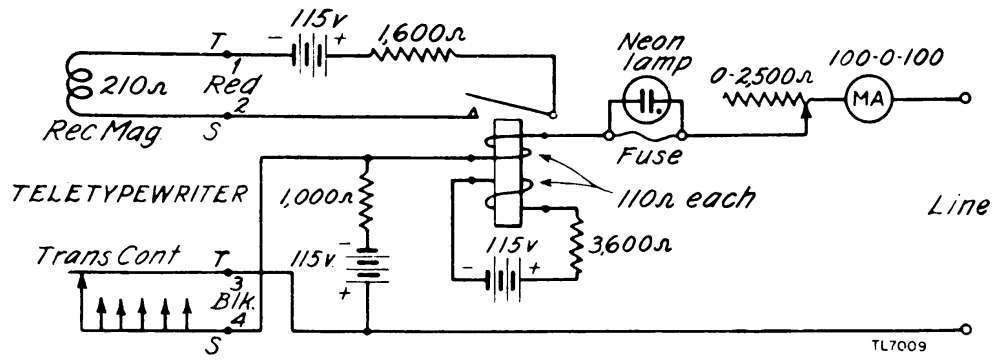
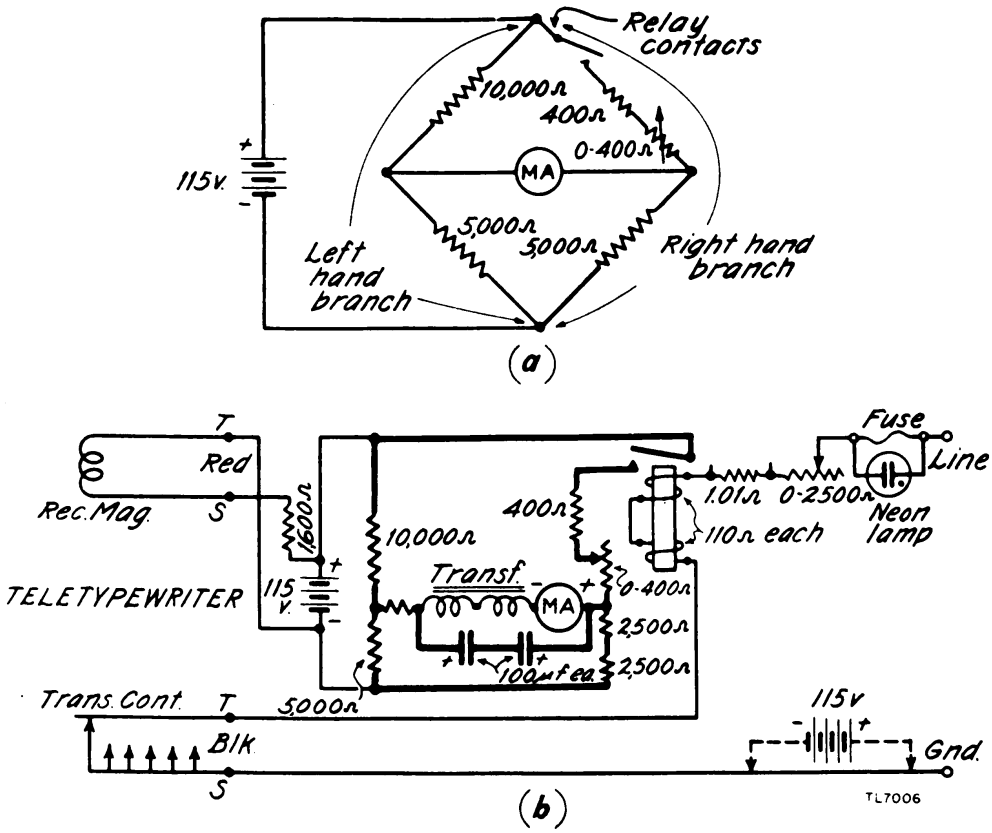


Figure 14.—Line Unit BE-77, simplified polarential operating circuit.

22. Voltage Measurement, Line Unit BE-77-A.—When the METER switch is held in the VOLTS position, the meter is disconnected from the line current shunt resistor and connected in series with a 150,000-ohm resistor and the line unit d-c power supply. A d-c voltage of 115 will then give a reading of 115 on the meter scale (center red mark of either group of three red marks). The meter reads about 150 volts full scale. Other voltages can be estimated. Transmission or reception of messages on the line circuit is unaffected by removal of the meter from across the line current shunt.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

23. Bias Measurement, Line Unit BE-77-A.—*a.* When the METER switch is thrown to the BIAS position, the local circuit is arranged as a bias measuring circuit (Fig. 15), and the meter is connected to it. The line circuit remains unchanged except for removal of the meter from connection across the line current shunt resistor. The teletypewriter receiving magnet is connected to the power supply through the 1,600-ohm resistor only and thus receives no signals while measuring bias (Fig. 15(b)).



Figures 15(a) and 15(b).—Line Unit BE-77-A, simplified bias-measuring circuit.

b. Bias in neutral teletypewriter systems is a form of signal distortion in which impulses of signal current are either longer (marking bias) or shorter (spacing bias) than the standard length of teletypewriter current impulses. By adjusting the tension on the armature spring of the line relay, it is frequently possible to obtain signal impulses of standard length (zero bias)

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

in the local circuit when the relay is actuated by line impulses having considerable distortion. Line signals are distorted principally by the line circuits over which they are transmitted, and the relay must usually be adjusted to the character of each line to which it is connected. The relay can be adjusted to compensate for line signals having marking bias by increasing the spring tension (turning the adjusting knob counterclockwise) on the relay armature so that it closes the contacts a little later and opens them a little earlier on each current impulse through the relay line winding. Likewise, spacing bias can be reduced by weakening the armature spring tension (turning the adjusting knob clockwise).

c. The bias measuring circuit is of the bridge type, shown in simplified form in Figure 15(a) and by the heavy lines in Figure 15(b). It is so proportioned and adjusted that when the relay contacts apply repeated space bar signals made up of current impulses of standard length to the right-hand branch of the circuit, the bridge will be balanced and no current will flow through the meter, thus indicating zero bias. The bridge is balanced when the average current through the right-hand branch equals the steady current through the left-hand branch. Thus, if the relay contacts apply current impulses which are longer than standard (marking bias), the average current through the right-hand branch will be greater. Consequently, the voltage drop across the lower right-hand bridge arm will be larger than that across the lower left-hand bridge arm, and current will flow through the meter from right to left, causing it to indicate marking bias. The effect is just the opposite when repeated space bar signals with spacing bias are applied by the relay contacts.

d. The 15,000-ohm resistor in series with the meter circuit protects the meter from overload. The transformer, used as a choke, and the capacitors in the meter circuit provide for a steady meter reading. Functions of other parts are given in the Table of Replaceable Parts in paragraph 29.

612465 O—44——5

Digitized by Google Original from UNIVERSITY OF CALIFORNIA

SECTION IV

MAINTENANCE

	Paragraph
Servicing	24
Meters	25
Fuse	26
Relay	27
Line Unit BE-77-A, bias circuit adjustment	28

24. Servicing. — Field servicing will generally consist of changing relays, replacing fuses, tightening loose parts, and keeping the unit clean. Repairs and adjustments within the equipment, except for changing relays and adjusting the relay knob, will be made only by qualified maintenance personnel. Wiring connections are shown in figure 16 (BE-77-A) and figure 11 (BE-77). Location of parts is shown in figure 17 (BE-77-A) and figure 5 (BE-77).

25. Meters. — The meter used with Line Unit BE-77-A requires a current of only 1 milliampere (0.1 volts across its terminals) for full-scale deflection. The meter used with Line Unit BE-77 has a built-in shunt and requires a current of 100 milliamperes for full-scale deflection.

CAUTION: HANDLE THE METERS VERY CAREFULLY. ALWAYS DISCONNECT THE METER TERMINALS BEFORE MAKING TESTS WITHIN THE UNITS. METER REPAIRS SHOULD BE MADE ONLY BY AN AUTHORIZED METER REPAIRMAN.

26. Fuse.—The ¼-ampere line circuit fuse is the only fuse used in this unit. With line voltage applied to the line terminals, a blown fuse is indicated by illumination of the neon lamp BLOWN FUSE INDICATOR. If this lamp glows, replace the fuse with a spare ¼-ampere fuse, usually carried in Chest CH-53-A and CH-53. Be sure that the 5-ampere fuse also carried in the chest for the rectifier is not mistaken for the ¼-ampere line unit fuse.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

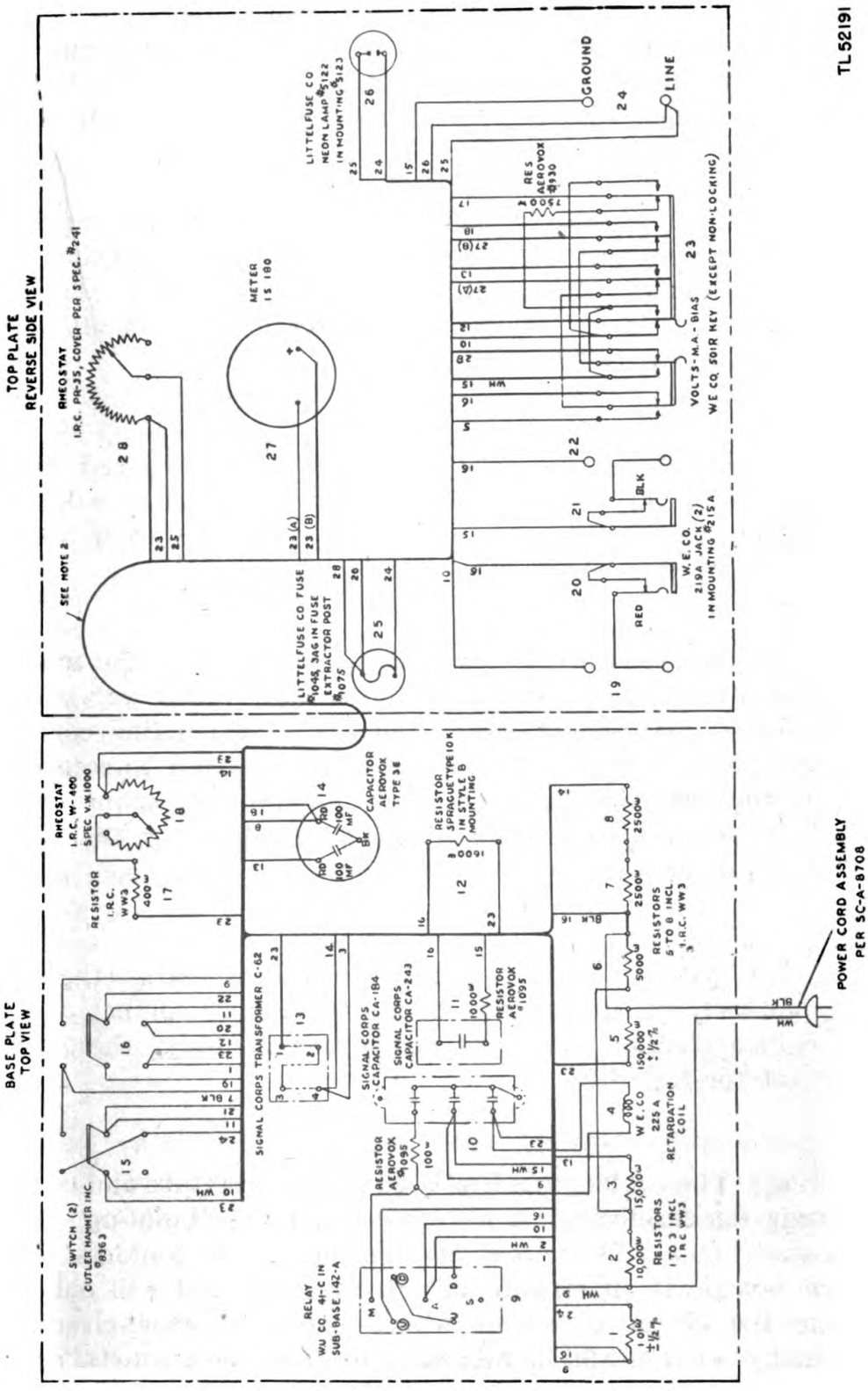


Figure 16.—Line Unit BE-77-A, wiring connections.

Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA

27. **Relay**—*a. Changing relays.*—The relay can be removed by pulling it out of the line unit through the door in the front of the line unit case. It may be replaced with any other Western Union type 41-A, 41-B, or 41-C relay in good condition.

b. Relay adjustment.—The relay should normally require no attention other than the adjustment of the spring tension when lining up circuits (par. 14). If possible, replace a relay that operates erratically. The following internal adjustments should be made only by a qualified repairman:

(1) The fixed air gap between the bearing end of the armature and the corresponding core face should be 0.008 inch This gap can be adjusted by loosening the screws which hold the core in place and shifting the core.

(2) With the armature contact held against the marking contact (normally open contact), the working air gap between the free end of the armature and the corresponding core face should be 0.006 inch. This length of air gap can be secured by adjusting the marking contact with a multiple spline wrench for No. 5 fluted-socket setscrew, two of which are included in Tool Equipment TE-50.

(3) With the armature contact still held against the marking contact, the distance between the spacing contact and the armature contact should be 0.003 inch. Adjust the spacing contact for this distance.

(4) The contact material used on the armature and contacts is tungsten carbide and is not subject to pits or build-up. Do not attempt to use a file or contact burnisher on the contacts. Tungsten carbide is an exceptionally hard metal and will cut chips from the file or burnisher which may later short-circuit the contacts. If it should be necessary to dress the contacts, remove them from the relay and grind them on a fine carborundum stone.

Digitized by Google Original from UNIVERSITY OF CALIFORNIA

28.—Line Unit BE-77-A, Bias Circuit Adjustment.—*a.* If it is suspected that the bias circuit is out of adjustment, it can be checked and adjusted only by use of a source of *standard test signals.* The following sources of standard test signals are listed in the order of preference:

(1) Teletype Corporation's Distortion Test Set, model DXD-1.

(2) Teletype Corporation's Test Transmitter, model 100-A.

(3) Teletype Corporation's Transmitter-Distributor, model 14. This is part of Reperforator Transmitter TG-26, which is a component part of Teletypewriter Set TC-16. It is also part of Teletypewriter Sets TG-19, TG-20, TG-21, and TG-22, Perforator Transmitter Sets TG-23 and TG-24, and Reperforator Transmitter Set TG-25.

b. Arrange the test signal source to supply unbiased, repeated space bar signals without line current supply. Unplug the relay from the line unit and connect the leads from the test signal source to the A and M terminals on the relay socket (subbase). Connect the line unit power cord to a source of about 115 volts direct current. Hold the METER key in the BIAS position and note the reading on the meter. If the bias meter circuit is correctly adjusted the vibrations of the meter needle will center on the zero mark on the meter scale. The reading can be corrected by means of the 0-400-ohm rheostat in the bias measuring circuit. The rheostat adjusting shaft has a screw driver slot and is covered by the cap nut to the left of the toggle switches.

CAUTION: ADJUSTMENT OF THIS 0 TO 400-OHM RHEOSTAT IS TO BE MADE ONLY BY AUTHORIZED MAINTENANCE PERSONNEL USING STANDARD TEST SIGNALS AS ABOVE.

Digitized by Google Original from UNIVERSITY OF CALIFORNIA

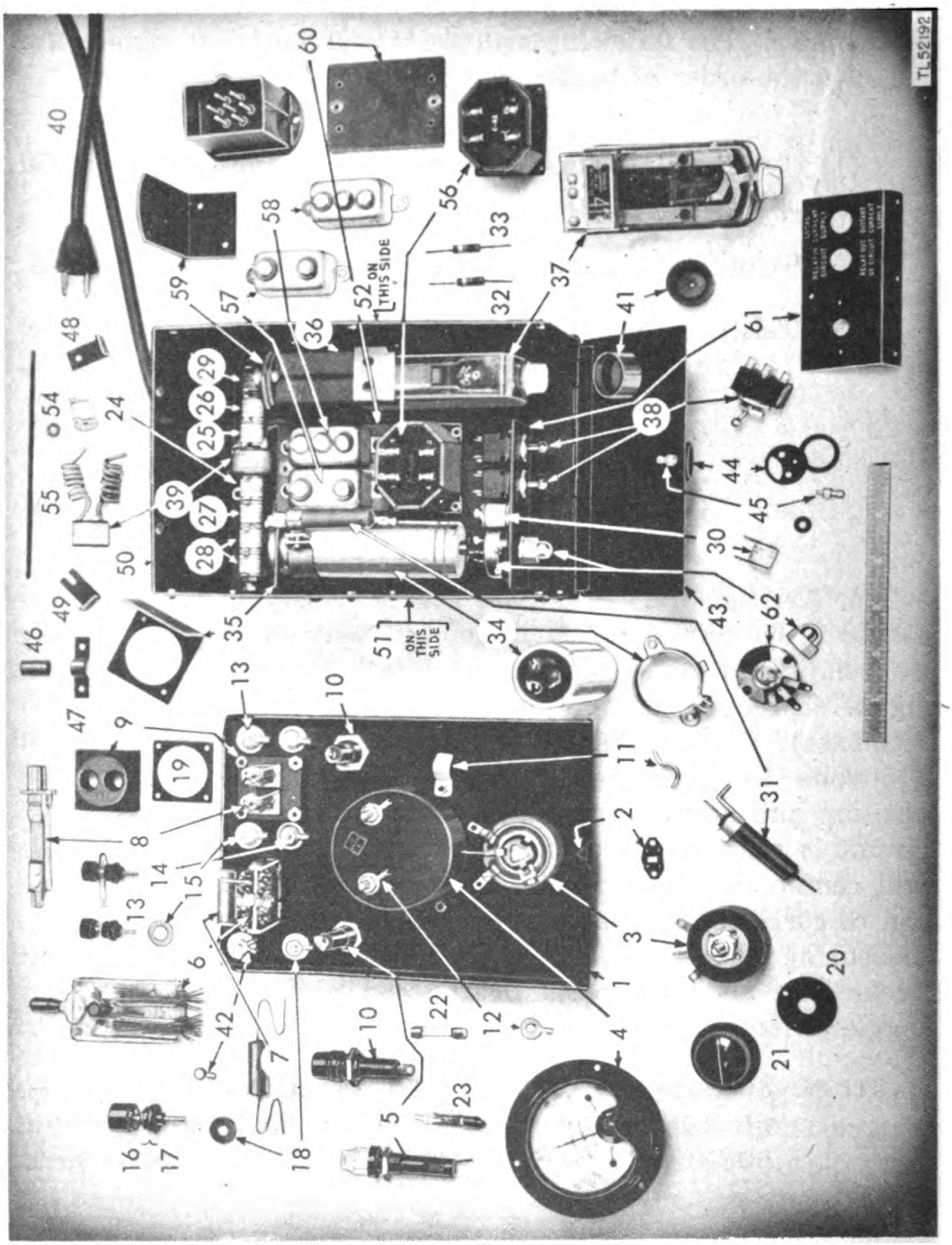


Figure 17.—Line Unit BE-77-A, location of parts.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

c. When using the model 14 transmitter-distributor, it is necessary to perforate a tape with repeated space bar signals. Be sure that the transmitter-distributor is properly adjusted and that there are no accumulations of dirt between the ends of the commutator segments.

d. In very exceptional circumstances the transmitting contacts circuit of a *well adjusted* teletypewriter keyboard may be used to supply the test signal. A simple method of making a *rough field check* on the bias measuring circuit is the following:

(1) Put the relay in the circuit with its adjusting knob set half way between the extreme ends of the adjustment.

(2) Connect the line and ground binding posts together and supply line current.

(3) Adjust the line current to 60 milliamperes, send repeated space bar signals from the associated teletypewriter keyboard, throw the meter key to BIAS, and check the reading.

(4) If the reading is more than 10 percent above or below zero, readjust the bias circuit as in subparagraphs *a* and *b* above. *Be sure to use a standard test signal when readjusting.*

SECTION V

SUPPLEMENTARY DATA

	Paragraph
Table of Replaceable Parts for Line Unit BE-77-A	29
Table of Replaceable Parts for Line Unit BE-77	30
Names and addresses of manufacturers	31

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

29. LIST OF REPLACEABLE PARTS FOR LINE UNIT BE-77-A

NOTE: The list of stock numbers is intended to supplement the Signal Corps General Catalog until such time as the Catalog is revised to include the stock nos. herein. Order replacement parts by stock numbers and description.

Quantity In Equip.	Ref. Symbol	Sig. C. Stock No.	Name of Part and Description	Function	Mfr. Code	Dwg. or Part No.
1	1		Top Plate, Steel, 8¼" x 6" x ½", Black Paint Finish, White Lettering, complete with Catch for Door Stud.	Mounts meter, key, etc.	AS	SCD-8703-6 Modified, plus catch.
1	2		Catch, Spring Steel, Parkerized, $\frac{15}{16}$" x $\frac{7}{16}$" x ¼".	Rivets to Cover to engage Stud on Door.	TP	1663-020
*1	3	3Z7325	Rheostat, wire wound, 2500 ohms, 25-watt, no taper, body 1⅝" dia. x 1⅛" deep, bushing ⅜"-32 x ⅜" long, shaft ¼" dia. x $\frac{15}{16}$" long from body, insulated contact arm, flat on shaft on same side as contact wiper.	Adjusts line current.	CL	H-6263
*1	4	3F7380	Voltammeter IS-180, 1-0-1 ma., adjusted to 100 ohms ±½%, scale 100-0-100 ma. (used with external shunt) or 115-0-115 volts (used with external multiplier) D'Arsonval movement, flange 3½" dia.; body 2¾" dia. x 1⅜" deep, round flush mounting, molded case, calibrated for $\frac{1}{16}$" steel panel. #10-32 terminal studs on back, ¾" long.	Indicates volts or milliamperes.	ME	
*1	5	2Z5984.2	Lamp Mounting, Littelfuse No. 1414, molded phenolic, 3" long x ¾" dia., including transparent molded cap, with locknut. Mounts in ½" dia. hole.	Mounts blown fuse indicating lamp.	LF	1414

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

*1	6	4C5105.1R	Key Switch, WE Type 501-R Non-locking, four S.P.D.T. Contact Assemblies on one side of the center position, and two S.P.D.T. and one S.P.S.T. Contact Assemblies on other side of center position, black insulated handle. Overall size 4¼" x ¾" x 1½". Four mounting holes tapped #3-56, on $\frac{11}{32}$" x $1\frac{3}{16}$" centers. With mounting screws.	Changes connections on meter, etc.	WE	D-123379
*1	7		Resistor, 7500 ohms, ±5%, ceramic, 5 watts, ½" dia. x 1½" long, solid axial flexible leads.	Charging resistor for capacitor.	SP	5K with wire leads.
*2	8	4C4819A	Jack, WE #219A, 3½" x ⅞" x ⅝", single closed circuit, fits in $\frac{7}{16}$" dia. mounting hole, furnished with one #6-32 x ⅜" screw for fastening.	For PRINTER connections.	WE	219A
1	9		Jack Mounting, black phenolic plate, 1½" x 1½" x ⅝"T, including circular boss 1¼" dia. x $\frac{3}{16}$", with two $\frac{7}{16}$" dia. holes for jacks and four $\frac{5}{32}$" dia. mounting holes on $1\frac{3}{16}$" x $1\frac{3}{16}$" centers.	Insulates jacks.	WE	215A
1	10	3Z3229	Fuse Extractor Post, molded phenolic, ¾" dia. x 2½" long, mounts in ⅝" dia. hole. Removable cap. With locknut.	Mounts ¼ Amp. Fuse.	BM	HCM
*1	11		Harness Clamp, Steel, zinc plated, ⅜" x 1" x .032"T, radius of clamp ¼".	Clamps wiring harness to top cover.	ARH	2365
*2	12	3Z12076-4	Terminal Lug, brass, hot tinned, ¾" long x ½" wide, with hole for #10 screw.	Connects wires to meter studs.	PM	2056-#10
*2	13	3Z737-13	Binding Post, black molded phenolic, ½" dia. x 1¼" long, including #6-32 threaded stud $\frac{7}{16}$" long, non-removable top.	Binding Posts for PRINTER connections.	EBY	#38 Ensign P-4 †SCD-8701-29

* Furnished as part of maintenance parts groups. † Indicates Signal Corps drawing and detail number.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

LIST OF REPLACEABLE PARTS FOR LINE UNIT BE-77-A (Cont'd)

Quantity In Equip.	Ref. Symbol	Sig. C. Stock No.	Name of Part and Description	Function	Mfr. Code	Dwg. or Part No.
*2	14	3Z737-13	Binding Post and Link Assembly, same as above with slotted connecting link ½" x 1⅜" x .032"T assembled to it.	Binding Posts for PRINTER connections.	EBY	#38 Ensign P-4, modified. †SCD-8701 Item 29 assembled with item 22.
4	15		Spacer, phenolic, ⅝" O.D. x 23/64" I.D. x 3/32"T.	Insulates PRINTER Binding Posts.	AS	†SCD-8704-16
*1	16	3Z737-11	Binding Post, engraved LINE, ¾" dia. x 1⅝" long, including #8-32 threaded stud ½" long.	Connects line.	EBY	46—LINE
*1	17	3Z737-12	Same as Ref. 16, except engraved GND.	Connects ground.	EBY	46—GND
2	18		Spacer, Natural Phenolic, ⅝" O.D. x 5/16" I.D. x 5/32"T.	Insulates LINE and GND Binding Posts.	AS	†SCD-8704-15
1	19		Spacer, Washer, Steel, Parkerized, 1¼" I.D., 1 15/32" square outside, ⅛"T, with four .154" holes on 1 5/16" x 1 3/16" centers.	Used between top plate 1 and Jack Mounting 9.	AS	†SCD-8703-9
1	20		Spacer, Steel, 1¼" O.D. x 25/64" I.D. x ⅛"T, with two #4-40 tapped mounting holes and one .144" dia. locating hole.	Locates rheostat.	AS	†SCD-8703-8
*1	21	2Z5747	Knob, black molded phenolic, 1½" dia. x ⅞"H, with ¼" brass bushing, with set screw, with indicating arrow.	Operates rheostat.	KK	S18-3L

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

*1	22	3Z2587	Fuse, glass enclosed, ¼" dia. x 1¼" long, ¼ amp.	Protects line circuit.	LF	1045-3AG
*1	23	2Z5888	Neon Lamp, ¼" dia. x 1⅝" long, with insulated base and contacts. Used with Littelfuse No. 1414 Lamp Mounting.	Indicates blown fuse.	LF	5122
*1	24		Resistor, fixed, precision, ceramic, 150,000 ohms, ±½%, $\frac{9}{16}$" dia. x $\frac{9}{16}$" long, .140" axial hole, with rigid soldering lugs ⅜ long.	Used in series with meter for VOLTS indication.	S	183A
*1	25	3Z6615-45	Same as Ref. No. 24, except 15,000 ohms ±1%.	Used in bias measuring network.	S	183A
*1	26	3Z6610-80	Same as Ref. No. 24, except 10,000 ohms ±1%.	Used in bias measuring network.	S	183A
*1	27	3Z6500-81	Same as Ref. No. 24, except 5,000 ohms ±1%.	Used in bias measuring network.	S	183A
*2	28	3Z6250-33	Same as Ref. No. 24, except 2,500 ohms ±1%.	Used in bias measuring network.	S	183A
*1	29		Same as Ref. No. 24, except 1.01 ohms ±¾%.	Meter Shunt.	S	183A
*1	30	3Z6040-17	Same as Ref. No. 24, except 400 ohms ±1%.	In series with 400 ohm rheostat.	S	183A
*1	31		Resistor, fixed, 1600 ohms, ±5%, 10 watts, ceramic, ½" dia. x 3" long, including straight axial lugs. With mounting.	Limits current to Selector Magnet.	SP	10K with solder lugs and Style B mount.
*1	32	3Z6010-18	Resistor, fixed, wire wound, insulated, 100 ohms ±10%, ½ watt, $\frac{3}{16}$" dia. x ⅝" long with flexible axial leads.	Radio filter circuit for relay contacts.	IRC	BW1/2—100 ohms
*1	33		Same as Ref. No. 32, except 1000 ohms ±10%.	Filter circuit for transmitting contacts.	IRC	BW1/2—1000 ohms

* Furnished as part of maintenance parts groups. † Indicates Signal Corps drawing and detail number.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

LIST OF REPLACEABLE PARTS FOR LINE UNIT BE-77-A (Cont'd)

Quantity In Equip.	Ref. Symbol	Sig. C. Stock No.	Name of Part and Description	Function	Mfr. Code	Dwg. or Part No.
*1	34	3DB100-1	Capacitor, fixed, dual, 100-100 mfd., 200 volt working, electrolytic, aluminum can, 1⅜" dia. x 4⅞" long including three insulated terminals extending ⅜" from insulated end of can. Black common negative insulated from can. With mounting ring having mounting holes $1\frac{3}{16}$" apart.	Used in BIAS measuring circuit.	AC	3E (EP-N11)
1	35		Bracket, angle, steel, 1¼" x 2" x 1¾" x #13 U.S.S. ga. with $1\frac{3}{32}$" dia. hole.	For mounting capacitor.	AS	†SCD-8702-4
*1	36	2Z7117.1	Relay subbase, socket type, black molded phenolic, with seven banana plugs molded in, for Western Union Telegraph Co. #41-C Relay, 2½" x $1\frac{9}{16}$" x 1⅞" high, with two .175" dia. mounting holes $2\frac{3}{16}$" apart. Western Union Telegraph Co. #142-A.	Holds relay.	AS	†SCD-8701-36
*1	37	4T103556	Relay, single current, S.P.D.T. contacts, with tension adjusting knob, transparent plastic case, with 7-point socket base for use with #142-A Relay Subbase. 4¾" x 1⅞" x 1⅜". Western Union Telegraph Co. #41-C.	Repeats telegraph impulses.	BU	WU #41-C
*2	38	3Z8142	Switch, D.P.D.T., toggle, molded black phenolic body, $1\frac{3}{16}$" x $\frac{11}{16}$" x $\frac{13}{16}$" deep, with six terminal lugs on back and ⅜"-32 x $\frac{5}{16}$" bushing and metal toggle handle extending ½" from end of bushing.	Change relay connections and current supply connections.	CH	8363

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

*1	39	3C1988	Retardation Coil, 7/8" dia. x 1 1/8" long with .175" hole through axis, with two 8" insulated wire leads.	RF Choke in filter circuit for relay contacts.	WE	225A
*1	40	3E4059-7	Power Cord Assembly. 2-conductor #18 rubber insulated, rubber-jacketed cord 6' long with Belden soft rubber H-1047 attachment plug. Other end has conductors separated 2 1/2" and skinned 1/2".	Connects to power supply.	AS	†SCD-8701-25
1	41		Shock Absorber, phenolic plate, 1" dia. x 1/2"T with depression 3/4" dia. x 3/8" deep in one circular face and tapped hole #6-32 through center of other face.	Supports relay against loosening in transit.	AS	ACD-8701-96
*7	42	3Z12076-3	Terminal lug, 5/8" long x 5/16" wide with hole for a #8 screw, brass, tinned.	Connects wires to Binding Posts.	PM	992-#8
1	43		Base and Door Assembly, steel, black paint, 6" x 11 1/2" x 1/2", including hinged door 6" x 3 1/2". Includes ring pull and latching stud.	Main base.	AS	ACD-8701-107
1	44		Ring pull, steel, parkerized, 7/8" dia. x 1/8"T, with two locating holes and one rivet hole.	Rivets to door and latching stud.	AS	ACD-8701-113
1	45		Latching Stud, steel, cadmium plated, 1/4" dia. x 5/8" long.	Rivets to door and engages with catch.	TP	P100-062-5
1	46		Cable Sleeve, black varnished tubing, radio grade, 8 mm. I.D., 3 1/2" long.	Protects power cord where fastened by clamp.	AS	ACD-8701-124
1	47		Cable Clamp, steel, parkerized, 3/8" x 1 1/2" x .032".	Clamps power cord.	AS	†SCD-8704-19
1	48		Bracket, Angle, steel, parkerized, 1" x 1/2" x 1/2" x .050", with two .144" holes.	Supports one end of potential divider assembly.	AS	†SCD-8703-10 Modified

* Furnished as part of maintenance parts groups. † Indicates Signal Corps drawing and detail number.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

LIST OF REPLACEABLE PARTS FOR LINE UNIT BE-77-A (Cont'd)

Quantity In Equip.	Ref. Symbol	Sig. C. Stock No.	Name of Part and Description	Function	Mfr. Code	Dwg. or Part No.
1	49		Slotted Bracket, same as Ref. No. 48 except hole in 1" leg is slotted to edge of piece.	Supports one end of potential divider assembly.	AS	†SCD-8703-10 Modified
1	50		Case Assembly, steel, black paint, 6" x 8" x 5" high, with 12 threaded inserts staked in place.	Encloses unit.	AS	†SCD-8702-1 Modified
1	51		Circuit plate, steel, etched, silver plated characters, 7 3/16" x 4 1/8" x .020".	Gives circuit information.	AS	†SCD-8707-24 Modified
1	52		Instruction plate, steel, etched, silver plated characters, 7 3/16" x 4 1/8" x .020"T.	Gives operating instructions	AS	†SCD-8707-23 Modified
15	54		Washer, black vulcanized fiber, 3/8" O.D. x 9/64" I.D. x .020"T.	Spacer and insulator for precision type resistors.	AS	†SCD-8701-86
1	55		Rod, steel, 1/8" dia. x 5 9/16" long, threaded #5-40 for 3/4" on each end, parkerized finish.	Holds resistors 25, 26, 27, 28, 29 and Retardation Coil 39.	AS	†SCD-8704-14
*1	56	2Z9662	Transformer C-62, AF, 1:1 ratio, 2" x 1 5/8" x 2" high, 4 mounting holes .120" dia. on 1 1/16" x 1 5/8" centers.	Used as a choke, with both windings in series.	FE	
*1	57	3D243	Capacitor CA-243, fixed, 0.5 mfd., 400 DCWV, paper, drawn steel case, 1 3/4" x 1" x 1 3/16" high. Mounting lugs with 3/16" holes 2 1/8" apart. Two insulated terminals on top surface.	Filter circuit for transmitting contacts.	PO	

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

*1	58	3D184	Capacitor CA-184, three 0.1 mfd. sections, 400 DCWV, one terminal of each section connected to case, other to one of three insulated terminals on top of case. Drawn steel case 1¾" x 1" x $1\frac{3}{16}$" H. Mounting lugs with $\frac{3}{16}$" holes 2⅛" apart.	Filter circuit for relay contacts.	PO	
1	59		Support, angle, steel, parkerized, 3" x 1¼" x $1\frac{9}{16}$" x #13 U.S.S. ga.	Mounts relay sub-base.	AS	†SCD-8702-3
1	60		Spacer, natural phenolic plate, 2⅝" x 2" x ¼"T with two brass inserts threaded #6-32, and four tapped holes threaded #6-32 for mounting capacitors CA-243 and CA-184.	Mounts and insulates capacitors.	AS	†SCD-8704-17 with brass inserts added.
1	61		Support, angle, steel, $1\frac{5}{16}$" x ⅝" x 3¾" x #13 U.S.S. ga., lettered, with holes for mounting two switches, rheostat and fixed resistor.	Mounts switches, rheostat and resistor.	AS	†SCD-8703-7
*1	62	2Z7292-400	Rheostat, wire wound, 0-400 ohms, 2 watts, no taper, enclosed, body 1¼" dia. x $\frac{9}{16}$" deep, bushing ⅜"-32 x ⅜" long, shaft ¼" dia. x ½" long, with screwdriver slot in end. Equipped with lock nuts and acorn type capnut.	Adjusts charging current.	IRC	VW-1508

* Furnished as part of maintenance parts groups. † Indicates Signal Corps drawing and detail number.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

TABLE OF STANDARD NUTS, BOLTS, SCREWS, AND WASHERS FOR LINE UNIT BE-77-A

Legend:
RHMS = Round Head Machine Screw
FHMS = Flat Head Machine Screw
Fil. Hd. MS = Filister Head Machine Screw
SBBP = Steel, Bonderized, Black Painted
SEG = Steel, Electro galvanized

Quantity	Description	Size	Length	Where Used
4	RHMS, SBBP	#2-56	1/8"	Fasten Nameplate
12	RHMS, SBBP	#3-48	3/16"	6 Fasten Circuit Plate 51 6 Fasten Instruction Plate 52
12	Hex Nut, SEG	#3-48		Used with above screws
2	FHMS, SBBP	#4-40	3/16"	Fasten Spacer 20
4	FHMS, SBBP	#4-40	1/4"	Mount Transformer 56
2	RHMS, SBBP	#4-40	3/8"	Mount Meter 4
1	RHMS, SBBP	#4-40	1/2"	Mounts Meter 4 and Harness Clamp 11
7	Hex Nut, SEG	#4-40		4 on Transformer 56, 3 on Meter 4
7	Standard Lockwasher, SEG	#4		Used with above nuts
3	Hex Nut, SEG	#5-40		Used on Potential Divider
4	RHMS, SBBP	#6-32	3/16"	Mount Capacitors 57 and 58 on Spacer 60
1	Oval Bdg. Hd. Mach. Screw, SBBP	#6-32	3/16"	Fastens Shock Absorber 41 to Door
12	Oval Bdg. Hd. Mach. Screw, SBBP	#6-32	1/4"	Fasten Case 50 to Base and Door Assembly 43 and Top Plate 1
4	RHMS, SBBP	#6-32	5/16"	2 Fasten Mounting Ring of Capacitor 34 to Bracket 35 2 Fasten Spacer 60 to Base Plate 43
3	FHMS, SBBP	#6-32	5/16"	Fasten Support 61 to Base Plate 43

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

8	FHMS, SBBP	#6-32	3/8"	2 on Bracket 35 2 on Support 59 2 on Cable Clamp 47
4	FHMS, SBBP	#6-32	3/4"	Secure Jack Mounting 9
1	RHMS, SBBP	#6-32	7/8"	Secures Resistor 30 on Support 61
22	Hex Nut, SEG	#6-32		2 on Bracket 35 2 on Support 59 2 on Cable Clamp 47 3 on Support 61 2 on Capacitor Mounting Ring 34 2 on Jack Mounting 9 1 on Resistor 30 on Support 61 8 on PRINTER Binding Posts 13 and 14
2	Hex Nut, 1/4" AF, SEG	#6-32		Jack Mounting 9 (on screws nearest mounting tabs of jacks)
24	Standard Lockwasher, SEG	#6		Used with above #6-32 nuts
2	RHMS, SBBP	#8-32	1/2"	Mount Relay Subbase 36 on Support 59
6	Hex Nut, SEG	#8-32		2 with above #8-32 screws 4 on LINE and GND Binding Posts 16 and 17
4	Standard Lockwasher, SEG	#8		2 with above screws 1 each on LINE and GND Binding Posts 16 and 17
4	Plain Washer, Small Pattern, SEG	#6		3 on Potential Divider Assembly 1 on Resistor 30 on Support 61
4	Plain Washer, Large Pattern, SEG	#6		On PRINTER Binding Posts 13 and 14
2	Plain Washer, Large Pattern, SEG	#8		On LINE and GND Binding Posts 16 and 17
2	Standard Lockwasher, SEG	#10		On Studs of Meter 4
2	Rivet, C'sk Hd., SEG	1/8"	5/32"	Secure Catch 2 on Top Plate 1

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

30. TABLE OF REPLACEABLE PARTS FOR BE-77

Signal Corps Stock No.	Description	Function	Manufacturer	Manufacturer's List No.	Signal Corps Drawing No. SC-D-5059 Item No.
4A1377/C1	Coil, retardation	Radio filter	WE	225	16
4A1377/B3	Relay and sub-base	Line relay and mounting	WU	41-B relay and 142-A mounting	17
4A1377/R1	Relay and cover, less sub-base	Line relay	WU	41-B	18
3F910-9	Milliammeter, bakelite case, scale 100-0-100	Line milliammeter	W	301	19
4A1377/J1	Jack	Printer jack	WE	219A	20
4A1377/T1	Terminal punching	Power terminal	WE	18A	21
3Z6160-1	Resistor, 1,600 ohms	———	SP	10K*	22
3Z6360-1	Resistor, 3,600 ohms	———	SP	do	
4A1377/R2	Resistor, 1,000 ohms	———	SP	25-K*	23
3Z6010-21	Resistor, 100 ohms	———	AC	1097	24
3Z1325	Rheostat, 0-2,500 ohms	Line rheostat	IRC	PR-322-2	25
3Z8401	Switch, d.p.d.t.	Local-distant battery switch	CH	8363 with ¼" bushing	31
3Z8401	Switch, d.p.d.t.	Relay in-out switch	CH	do	31
3Z9505	Switch, 3 p.d.t.	Polar-neutral switch	CH	8668	32
4A1377/K1	Knob, black	Line rheostat knob	KK	18	36
3Z3329	Fuse mounting with neon blown fuse indicator	———	LF	SP-19	37
3Z252	Binding post TM-152	Printer terminals	———	———	33
3Z209	Binding post TM-109	Line terminals	———	———	34
3D276	Capacitor CA-276 (0.1-0.1 μf)	Radio filter	———	———	35

*Indicates with standard terminals.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

31. MANUFACTURERS' NAMES AND ADDRESSES

Abbrev.	
AS	Automatic Signal Corporation, Regent Street, East Norwalk, Conn.
AC	Aerovox Corporation, New Bedford, Mass.
ARH	American Radio Hardware Co., 476 Broadway, New York City
BM	Bussman Mfg. Co., St. Louis, Missouri
BU	J. H. Bunnell & Co., 81 Prospect Street, Brooklyn, N. Y.
CH	Cutler-Hammer, Inc., 8 West 40th Street, New York City
CL	Clarostat Mfg. Co., Inc., 285 North 6th Street, Brooklyn, N. Y.
EBY	Hugh H. Eby Mfg. Co., Philadelphia, Pa.
FE	Ferranti Electric, Inc., 30 Rockefeller Plaza, New York City
IRC	International Resistance Co., 401 North Broad Street, Philadelphia, Pa.
KK	Kurz-Kasch Co., Dayton, Ohio
LF	Littelfuse, Inc., 4757 Ravenswood Avenue, Chicago, Ill.
ME	Marion Electrical Instrument Co., Manchester, N. H.
PM	Patton-MacGuyer Co., Providence, R. I.
PO	The Potter Company, North Chicago, Ill.
S	Shallcross Mfg. Co., Collingdale, Pa.
SP	Sprague Specialties Co., North Adams, Mass.
TP	Tinnerman Products, Inc., Cleveland, Ohio
W	Weston Electrical Instrument Co., Newark, N. J.
WE	Western Electric Co., Inc., Kearney, N. J.
WU	Western Union Telegraph Co., New York City

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

[A.G. 062.11 2 October 1943.]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

DISTRIBUTION:

IBn and H 1, 11 (5); IC 1, 11 (10).
(For explanation of symbols, see FM 21-6.)

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

NOTES

52
Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA

NOTES

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

NOTES

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

NOTES

Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA

NOTES

Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA

NOTES

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

NOTES

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

NOTES

Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA

NOTES

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

NOTES

Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA

Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA

Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA